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# Educational Television

For the past couple of years, a special committee set up by the Federal Government has been inquiring into the use of television for educational purposes. Among its various recommendations, the committee advised the Government to adhere to the long-standing concept of reserving channel space in the present VHF system for a network of educational transmitters.

The Government has rejected this plan on various grounds, including cost, utilisation of existing facilities and the availability of UHF channels for the various educational TV services, which it feels will ultimately become necessary.

To be sure, cost is a big factor which, in the end, touches all our pockets. It is understandable that the Government should be unwilling to spend millions of dollars on a new network while sufficient air-time for present needs is available on existing stations. But what happens from here on?

To date, VHF channel allocations have been made on the basis that an educational television network might have to be accommodated. With this possibility apparently removed, the Australian Broadcasting Control Board may well see in the situation an easy way out of present co-channel problems and proceed to fill up the bonus channels with "problem" transmitters and translators.

If the Federal Government believes, as apparently it does, that educational television is going to demand more than the present facilities, there will almost certainly come a day when an extra VHF channel would be invaluable—if space for it still exists!

The assumption that UHF channels will be able to meet all future needs is not necessarily a very practical one, because the special receiving facilities required will place a severe limit, for a long time, on the potential audience. Long-range plans are fine, provided they don't completely ignore more immediate needs.

While educational television is still evolving, and while the Federal and State Governments argue about who shall pay for what, the A.B.C.B. should be instructed not to reallocate any channel space originally envisaged for the educational network. In three or four years' time, we may need it desperately.

N. Williams

## une, 1966

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*COVER PICTURE: Torches and furnaces involving gas in a highly ionised or plasma state are the basis of a field of research known as "high temperature chemistry." In the range 3,000 to 30,000 degrees C. it is possible to produce reactions previously unobtainable and to process materials normally regarded as refractory or heat resistant. In the furnace pictured, the plasma jet is extended in length by the laminar principle, and in circumference by rotating the jet source at a few hundred revolutions per minute.*

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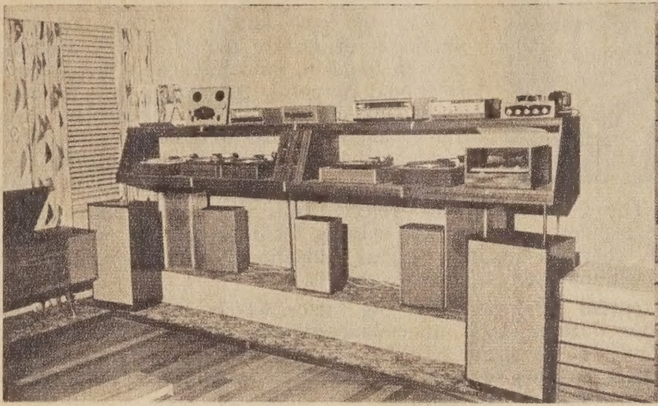

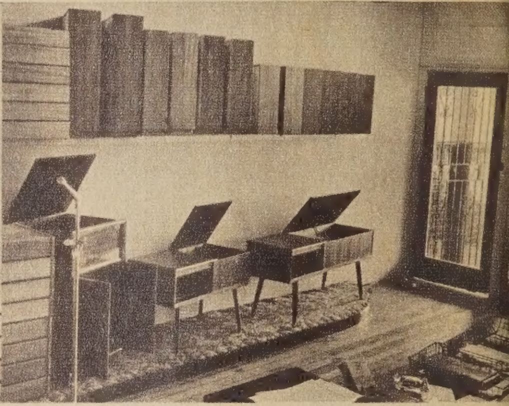

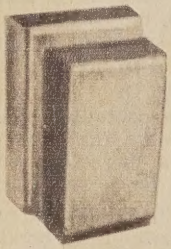

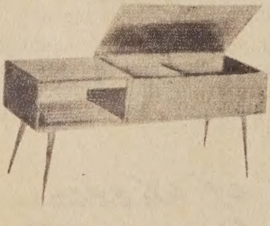

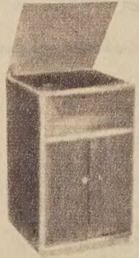

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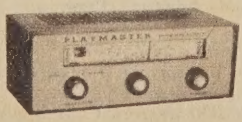

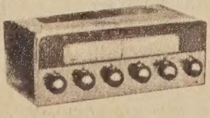

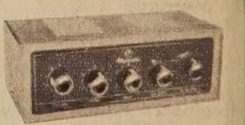

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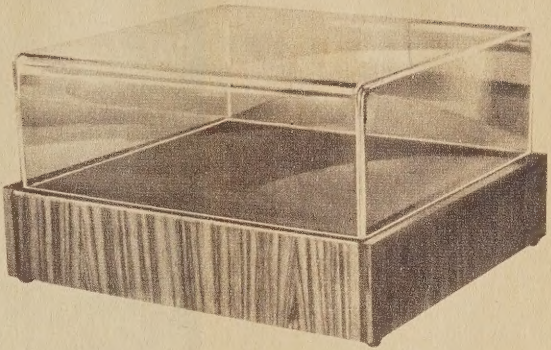

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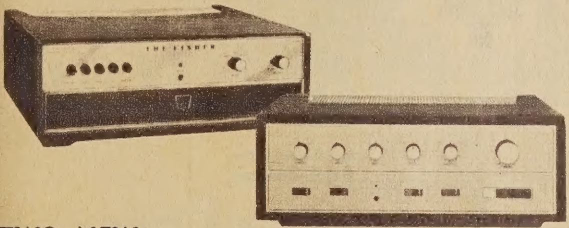

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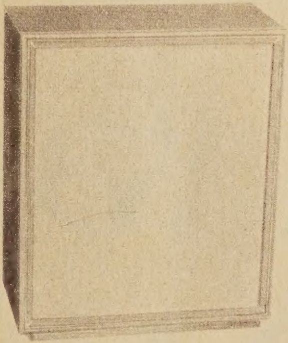

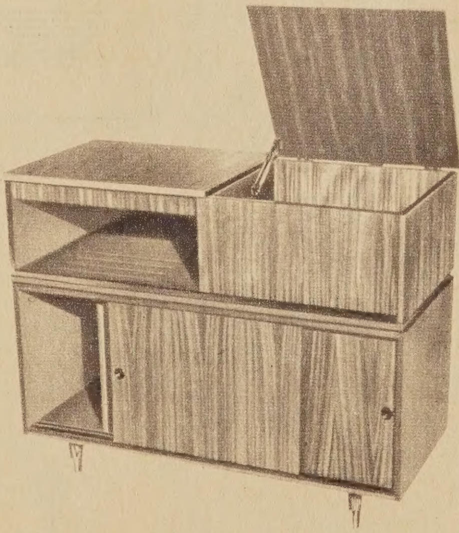

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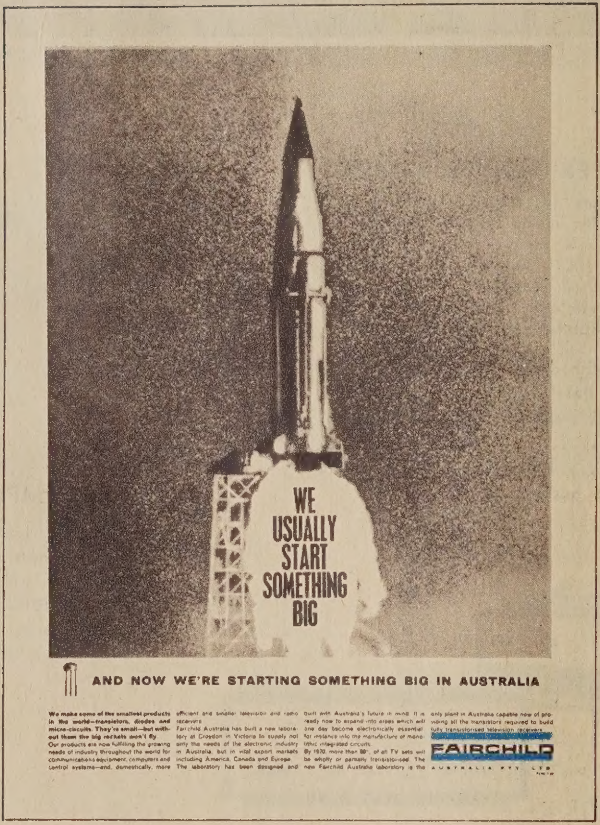
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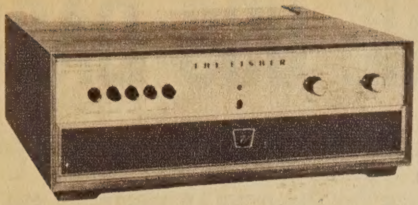

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with heavy-duty output circuitry, exclusive hinged cover over the less frequently used controls, centre-channel output for optional third speaker, front-panel headphone jack, complete phono and tape facilities: $296.

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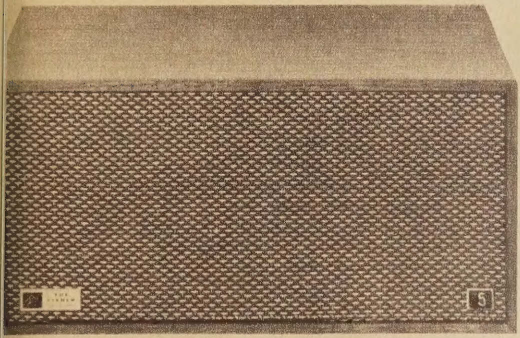

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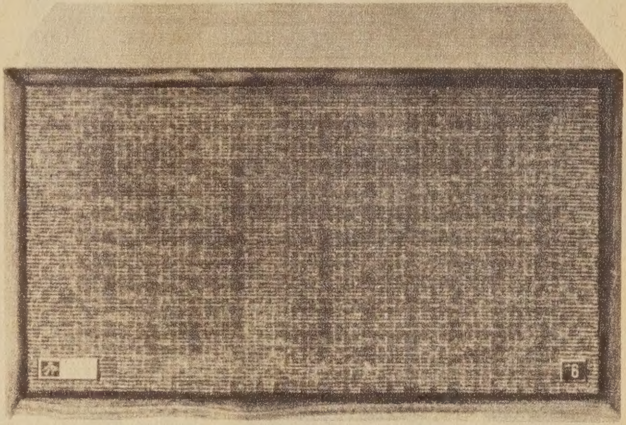

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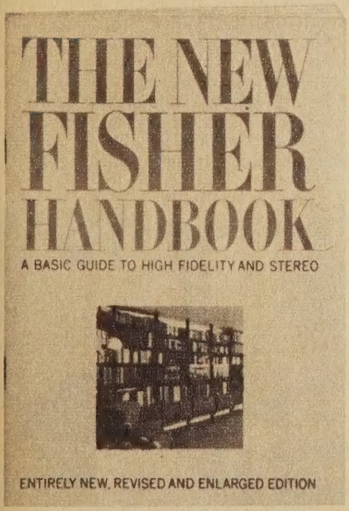

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*In submarines, like the USS Dace, the one-time conning tower is a streamlined structure referred to as the "sail," which houses a "cockpit" at the top. From its side extend "sail planes" — control surfaces which allow it to "fly" under water.*

# THE USS DACE

If a modern, nuclear-powered submarine is a triumph of nautical design, it is no less so for the mass of electronic equipment which it carries. It is powered, controlled, monitored and navigated by electronics, which also keep it in touch with the outside world. In combat, it locates, stalks and destroys its quarry — all by electronics!

The first nuclear-powered submarines received a mixe welcome at British ports, where people spoke uneasily o radiation dangers, but the nuclear reactors which provid the power for the new underwater craft are so well shielde that their crews actually get less radiation than that to whic the general public is exposed, since they are protected, no only from the source in their ship, but also from ambier cosmic radiation and emanations from the earth.

In U.S.S. Dace, 4,400 tons, latest nuclear sub in th U.S. Navy, a health-physics team constantly checks th reactor for leaks, by analysing the cooling water. A Beckman pH meter, a conductivity bridge and two integratin counters ensure it is so pure the crew calls it "holy water. They also use two radiac (radiation survey) instruments incorporating Geiger-Muller tubes t check for loose contamination. Geige counters to sample air are in the reacto compartment, engine room and auxiliar machinery space.

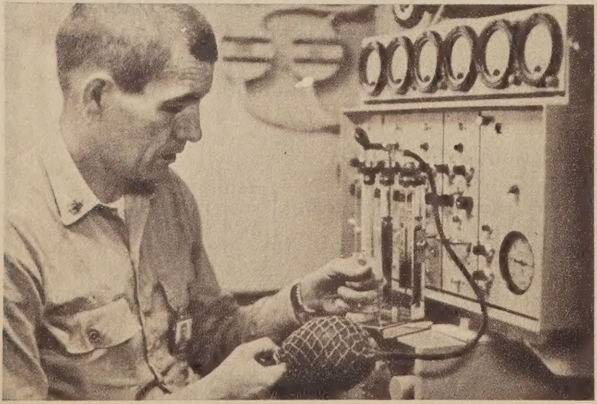
Each man wears a badge of photographic film that darkens to show how much radiation the wearer has receive and men working close to the reacto wear pocket dosimeters as well. The badges are checked every 30 days. A Weston densitometer reads the badges and, by selective masking, the health team is able to determine separately the wearer's exposure to alpha, beta o gamma radiation.

A Beckman analyser checks the ai regularly at 12 places in the ship. The instrument determines the percentage of carbon monoxide, carbon dioxide and Freon 12 by the use of infra-red and ultra-violet comparators. Five electrostatic precipitators clean the air.

A nuclear attack submarine such as Dace costs about $60 million, of which the basic hull absorbs only about $28-

*In underwater darkness, "Sonar" listening devices take over completely from the periscope and visual contact.*

*Commander of the USS Dace is John Amand Walsh, a native of Haiti and a naval officer for 20 years.*



*Because the propulsion equipment is a closed-circuit system, having no reliance on the outside atmosphere, Dace can remain submerged for more than 30 days. The air is closely monitored for toxic gases and oxygen content.*

*The submarine's attack centre — a complex of analog and digital computers. Here the course, speed, range and bearing of a target is computed and the data fed to the torpedo room, where the weapons are readied for launching.*

# —Electronics aboard a nuclear-powered submarine

By Bill Baverstock

million. Most of what's left goes for electronics. Dace is packed full of it!

But even in the construction of the basic hull, electronics played an active part. Instead of using the traditional full-scale templates of the ship's section when constructing the hull, the builders optically projected microfilms of drawings to full size while electronic analog-controlled equipment profiled steel plates to the shape required.

Of the provision for electronics, sonar takes the biggest bite. Modern subs are blind without it and Dace's equipment includes the latest development in "underwater acoustics," much of it on the secret list. Dace has no guns and only a few small arms. The armament consists of torpedoes of many types, all of which are guided, fired, aimed and controlled electronically. Electronics control the nuclear reactor and, of course, dominate Dace's more or less conventional marine gear, such as radio, radar, counter-measures equipment, depth finders and inertial navigation system.

When it goes on patrol, Dace's hatches are sealed with wax to fair the contours. The sub can stay at sea 90 days and is provisioned for that period. The reactor fuel lasts three years, but the reactor itself will run 20 years without maintenance. All equipment and spare parts can be produced on board as the machine shop is provided with an information retrieval system. This contains on microfilm the blueprint of any component part of the ship and can print out an electrostatic copy.

Learning the lesson set by the ill-fated sub Thresher, naval architects gave Dace 16 bottles of compressed air to blow the ballast tanks against Thresher's eight. All communications connections are silver brazed or welded and these are inspected radiographically or by ultrasonics.

Consisting of several systems the sonar "suite" is Dace's most expensive electronic equipment. The ship's "ears" are an integrated sonar consisting of a large ranging and listening set, a listen only set, a computer-indicator and an underwater communications system.

The Raytheon BQS-6 ranging and listening set, low in frequency, is so high in power that when it pings (transmits) in still water it makes a visible wave. A sphere 12ft diameter located in a free-flooding compartment outside the pressure hull away from the engine room noise is its antenna. This sphere's surface is a patchwork of 1,245 barium titanite transducers, which can ping-and-listen or just listen. Working all together they make up an omni directional sonar antenna. Selected transducers can be phased together to make up a scanning beam giving extremely precise discrimination when scanning either on azimuth or elevation. The latter is speciallv useful for getting the most out of bottom-bounce sonar. The active or ranging console of the set shows the heading of the beam and the stem line of the sub. The passive or listening console has an electrographic recorder that plots target signatures on a linear time-versus-bearing display.

The listen-only sonar works off a semi-ellipsoidal array of 156 hydrophones mounted in three rows in the ship's bows and extending 50ft aft. It has a recorder-analyser located in the control room. The computer-indicator that works with the ranging-and-listening set records range and bearing to target. It includes a digital computer that determines the rate of change of range and rate of change of bearing relative to the sub's own course and feeds this data direct to the fire-control computer in the control room. The remaining part of this system is the Raytheon underwater communication incorporating speech privacy equipment.

A classification sonar made by the Western Electric Co. has an audio recorder that can be used to capture target signatures on magnetic tape for later sound spectrum analysis using a variable audio-frequency filter, but the U.S.

*The weapons control panel in the torpedo room. When a target has been detected and relevant data processed by computers in the attack centre (earlier picture) the men and equipment in the torpedo room ready the weapons.*

*Control centre of the Dace, located directly between the "sail" and bridge area. The sailors seated are the helmsmen and planesman; the man standing is the diving officer.*

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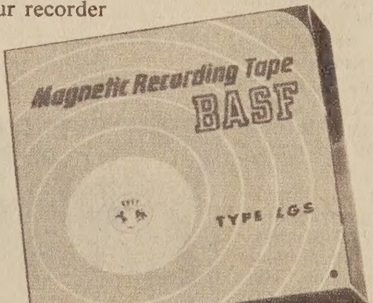

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Navy usually depends on the practis ears and eyes of experienced sonarme

To measure the distance from t submarine's keel to the bottom are depth finder and a Sperry digital dep recorder. The distance to the surfac on the under side of an ice pack, measured by another depth sounder.

For all this sonar gear to functi at peak efficiency, it is essential th the ship itself should make as lit noise as possible. As it stalks its pre Dace's sounds are picked up by t OSN (own ship's noise) analyser throu hydrophones on the hull and their lev is indicated by flashing neon light the sonar room. It works like t over-modulation monitor in audi recording work and there is also sound-and-vibration analyser in t machinery space.

Electronic control and guidance is evidence in all Dace's weapons — t torpedoes. True, Dace has some co ventional steam torpedoes with gyr scopes, which can be set for a collisi course with the target, but the ne hydrogen-peroxide torpedoes are fast leave no wake and can be controll throughout their course by signals se over a wire. The Mark 37 sonic to pedo homes on its target by means self-contained passive sonar.

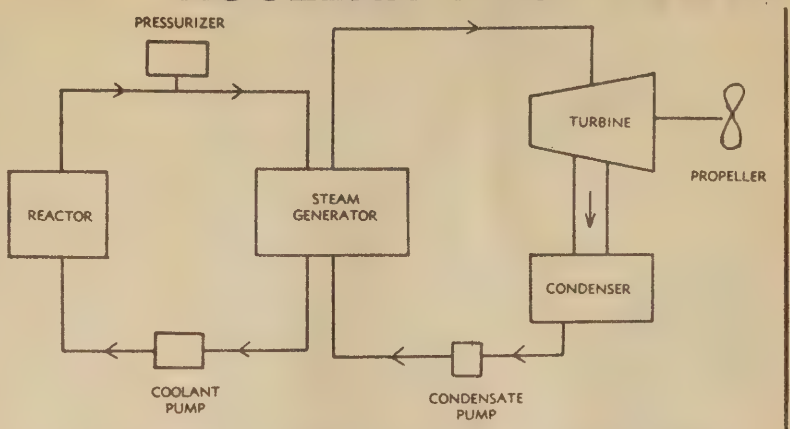
It is expected the two-ton SUBRO the submarine rocket, will soon be us in subs of Dace's class. This ne weapon is ejected by water pressu Once in the water the booster rock ignites and inertial guidance directs t SUBROC upwards, breaking the su face. Then it heads towards the targ which may be 30 miles distant a drops, functioning like a depth bom Well aft of the sonar sphere in t bows, the four torpedo tubes are angl 10 degrees off the sub's centre line reduce noise in the sonar.

When the sonarman at the passi console detects a target he reports direction to the operator at the acti console who immediately sweeps t sector and ranges on the target. T computer in turn computes the rate change of range and bearing and fee this data to one of two Librascope Ma 113 fire-control panels in the contr room. With its digital computer usi magnetic core storage this equipme solves the attack problem and makes the gyroscope setting for a torpedo intercept the target at the point sele ted. This computer can accept ran and bearing also from radar or visu reports.

In the torpedo room, weapons mo tors control the firing of the tubes. T port torpedoman opens the breech No. 1 tube by pushing button 1. T torpedo, held ready in chocks, is driv by hydraulic ram into the tube; butt 2 is pressed and the breech shuts. Pre ing button 3 floods the tube with wa and button 4 opens the muzzle do The tube is loaded and the torpe ready to be discharged, but if any butt had been pushed out of sequence omitted the weapons monitor wou lock out the rest of the firing cycle.

When the leading torpedoman gets t signal he depresses the firing swit there are thuds and a hiss and the "fis is away on its message of destructi Its discharge is accomplished by an a driven ram forcing water from an i pulse tube into the torpedo tube and driving the fish out. The impulse tu

## NUCLEAR PROPULSION



The advent of nuclear propulsion brought about the development of the true submersible because external air was no longer required for the operation of the propulsion plant.

The nuclear propulsion plant consists, basically, of two closed systems. In the primary system the pressurised water is heated in the reactor vessel by the controlled nuclear reaction of the uranium fuel. This water is in turn circulated by pumps through a steam generator or heat exchanger, where it gives up its heat to the water on the secondary side. This water is boiled to produce steam for operating the propulsion turbines and other auxiliary equipment. After passing through the turbines this steam is then condensed and returned to the steam generator to be converted to steam again.

then closes off; the port torpedoman ushes button five to close the muzzle oor and button six to drain the torpedo ibe.

Electronics not only gives the ship its ormidable fighting power and protection om radiation hazards, but directs where has to go and whether it is surfaced or ubmerged below periscope depth. Dace as such conventional navigation aids as oran, two dead-reckoning analysers, a perry Mark 19 gyroscope and a Litton ark 19 plotting board.

In addition, the SINS (Ships Inertial avigation System) makes use of the ERDAN (versatile digital analyser) omputer which can be used for supple- entary off-line computing. It incor- orates a magnetic-disc memory and is orrected for error more than once each ay.

A novel device is an electro-magnetic ogmeter, fixed to the sub's hull and not xtractable as in other ships. It has haft that protrudes into the water where n electro-magnet generates a field, otion of which through the sea creates voltage directly. This is picked up nd displayed as velocity, and also elec- ronically integrated to indicate distance ravelled to the navigational equipment, he fire-control equipment and engine oom.

An automatic course-control unit keeps he ship on course and corrects devia- ions of only one quarter of one degree.

ace's radio-room is under tight secur- ty because all messages are coded and ecoded there. Several retractable an- ennas are installed in the sub's sail, the .S. Navy's word for the tall slender onning tower of a modern submarine.

A receiver and loudspeaker system rovide entertainment for the crew. It as magnetic tape recorders for use hen the Dace is submerged.

Dace is the U.S. Navy's 19th nuclear ubmarine. Eventually she will have 26 ister ships — hunter killers that make ven the most deadly of the World War I U-Boats as anachronistic as the collar on a sailor's uniform — a hangover from the days of sail to prevent tarry pigtails soiling jackets!

FOOTNOTE: For those interested in ships, "Nautilus" was the first nuclear-powered submarine in the U.S. Navy, commissioned in 1954, with a length of 3,200ft and a displacement of 3,200 tons. "Seawolf" (1957) was generally similar to Nautilus. "Skate" and her three sister subs (Swordfish, Sargo, Seadragon) were smaller versions of the first two, 268ft long and displacing 2,360 tons.

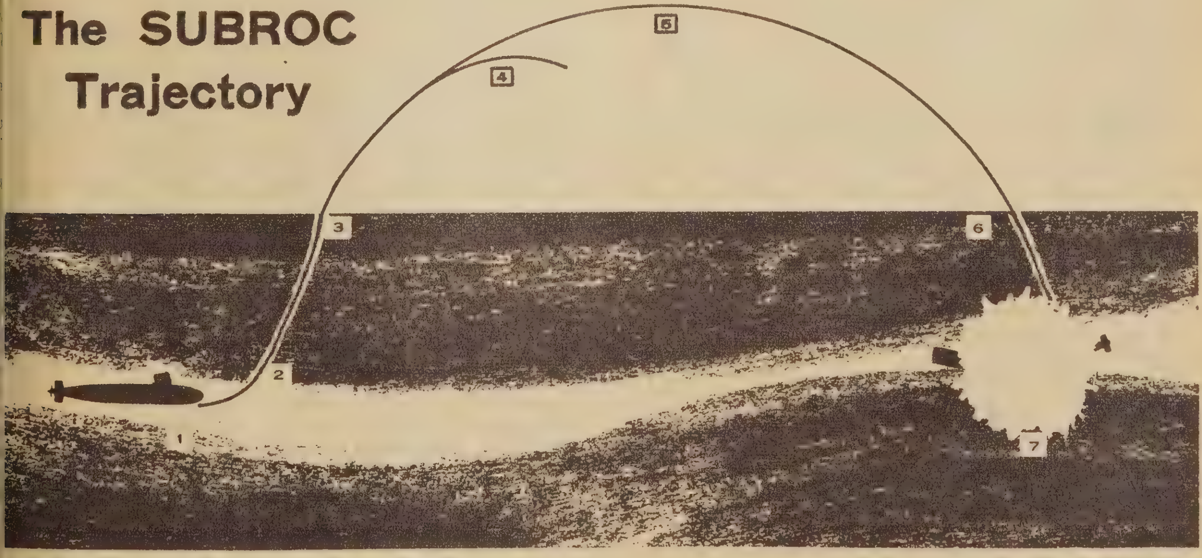
"Skipjack," shorter but heavier (2,830 tons) was the first of several ships with tear-drop shaped hulls, and control planes on the "sail" type conning tower, which allowed them to "fly" underwater. Speed is in excess of 20 knots.

"Triton" at 5,900 tons is the largest of all the nuclear subs. In 1960 it circumnavigated the earth fully submerged.

"Tulibee," one of the smaller subs, was the test-bed for the U.S. Navy's present sophisticated detection and attack equipment.

"Dace" (4,000 tons) one of about 25 "Thresher" class subs, built or building, incorporates the lessons of earlier types and is described as the "fastest, deepest, quietest, best-armed" of all. ■

## The SUBROC Trajectory



A target doesn't have much time to get away from a Subroc missile, nor to take evasive action. What little can be done by the target is of small importance, because of the lethal radius of the warhead. The drawing shows a typical path taken by a missile: (1) it is ejected from the submarine's torpedo tube using standard launching techniques; (2) the solid-propellant rocket motor ignites under water; (3) the missile leaves the ocean; (4) forward thrust in the motor exceeds the backward thrust and the motor separates from the bomb, the point of separation being determined by the required range; (5) the bomb continues under inertial guidance as a ballistic missile; (6) it strikes the ocean surface at supersonic speed and sinks to a predetermined depth where (7) it detonates. (Prepared by Ingalls Shipbuilding Division of Litton Industries.)

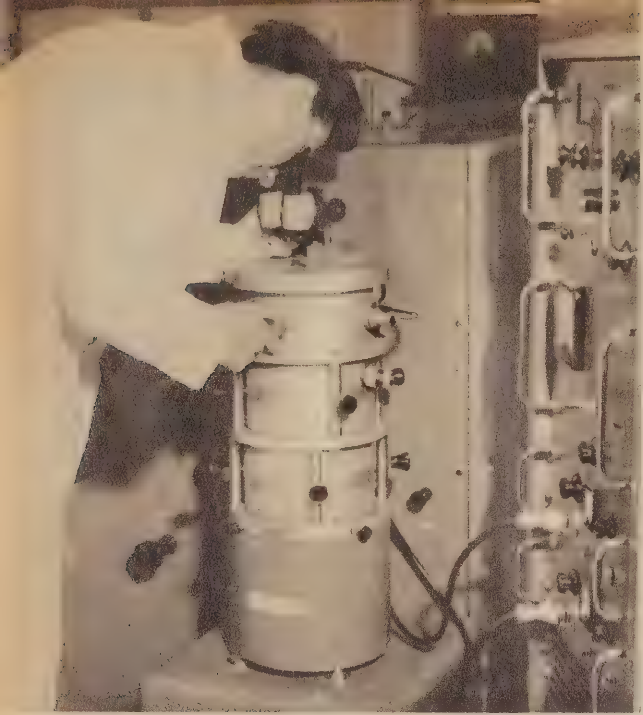


*Figure 2. Electron beam machine tool at Royal Radar Research Establishment, Malvern, U.K. This technique takes over where conventional photo-litho methods become impractical.*

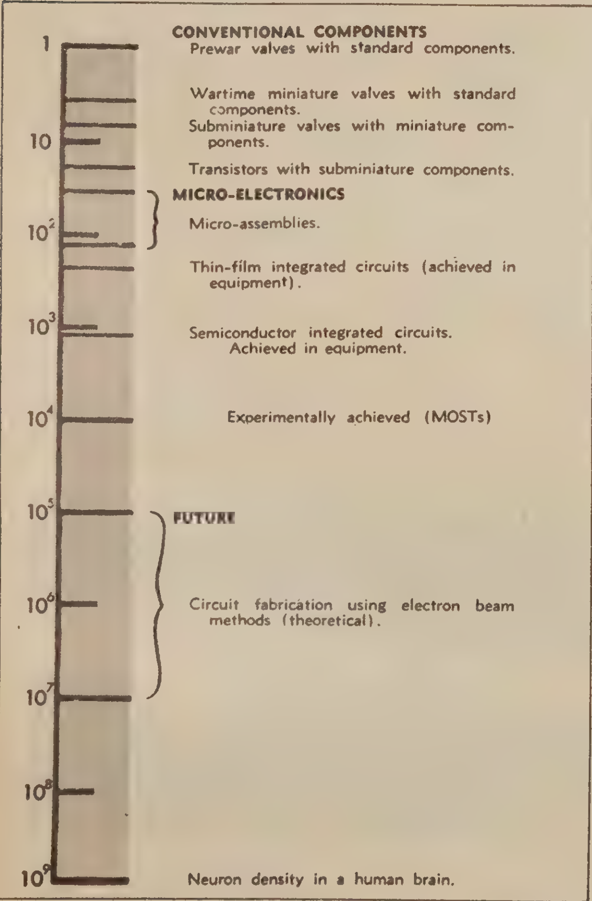


*Figure 1. Component packing densities (per cubic inch) for low power electronic circuits, including interconnections.*

# Miniaturisation *ad infinitum*

In the August and September 1965 issues we presented articles on miniaturisation by E. Laisk, M.Sc., which detailed the many techniques being employed. One of these was electron beam etching and this article from the "New Scientist" describes work being done along these lines in Britain. There is also reference to experiments in the U.S.A., which are aiming at an eventual component density equal to or exceeding the neuron density of the human brain.

### By G. W. A. DUMMER*

The public is scarcely used, yet, to the idea of "mici electronics," where entire electronic circuits containing pe haps dozens of components are packed into a container bigger than a transistor. Yet while micro-electronic devic originally developed for military systems, are now beginni to find their way into industrial and even domestic use, th by no means represent the limits of miniaturisation. Wo is already well advanced on the next generation of ev smaller devices.

Tables of "packing densities"—the number of comp nents that can be squeezed into a given volume—have be compiled in the past to give some indication of the futu possibilities of micro-electronics. While such tables can regarded as no more than approximate, figure 1 indicat that advances are being made in packing densities whi were quite inconceivable in the early postwar years, befo the advent of the transistor.

Components and transistors can now be made in th films, only a few micro-metres or even a few atoms thic where packing densities are measured in terms of componen per square inch rather than per cubic inch. We have no reached the position between $10^3$ and $10^4$ shown in figure Plainly, there is still a long way to go before we approa the packing density of the human brain, but the new metho of electron-beam technology may eventually open the wa to even these fantastic densities.

It is already obvious that computers are going to pla an ever-increasing part in our lives and that their range ar complexity will also increase to provide the extra memo and calculating facilities needed. It is also apparent that th must provide the required facilities with extremely hig reliability, and therefore "redundant" (component- circuit-paralleling) techniques will be used, which will aga increase the required component-packing density.

The use of electronic beams to fashion electronic d vices is comparatively recent, although electron beams ha been used elsewhere for many years. Pirani, in 1907, melte tantalum using an electronic beam; von Ardenne, in 193 drilled small holes in diaphragms for use in electron micr scopes; and electron-beam machining was patented in Ge many in 1942.

The electron-beam machine tool we are working with the Royal Radar Establishment is shown in figure 2; a sketc showing its main features is given in figure 3. A high-voltag beam of electrons is focused on to a small area of th material to be machined. When the beam strikes the materi the energy of the fast-moving electrons—they can b accelerated to speeds of the order of 100,000 miles a secon —is largely dissipated as heat, and an energy density of abou 10 megawatts per square millimetre can be produced. Henc the target material in the neighbourhood of the beam can b raised to several thousand degrees Centigrade.

The electron beam can be focused and controlled b suitable fields. Simply by pulsing the beam, or by controllin the voltage, the beam can be used to produce local meltin of surfaces to be welded, to drill holes, or to remove u wanted material by evaporation. Electron-beam technique

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* Royal Radar Establishment, Malvern, U.K.

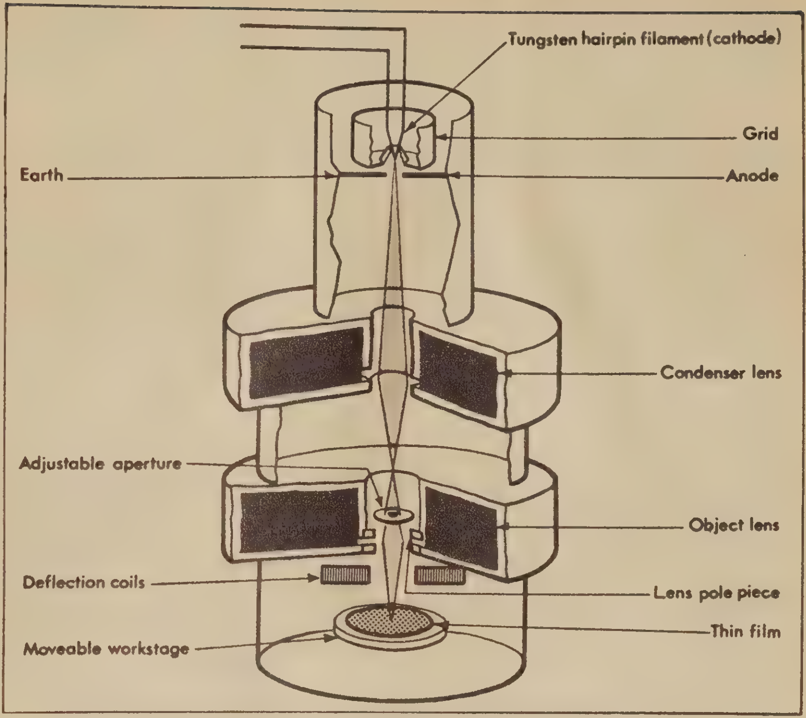


*Figure 3. Sketch of the electron optical system for a typical electron beam machine tool. It can cut, drill, weld, deposit conductors, and deposit insulators.*

e normally carried out in a high vac-ım, especially where high precision ıd accurate beam manipulation are quired.

The generation of a suitable electron am requires accelerating voltages be-een 5 and 150KV. For application micro-electronics a narrower range of, y, 15-25KV is probably adequate. :am currents of the order of 1mA /e a mean power of some 15-25 watts. ıe energy density depends on the arpness of focus, which is limited in e last resort by the stability of the wer supplies. For thin films of the der of 1 micrometre thick, and small cuit assemblies, the mean power re-ıirements are much less than those eded to machine relatively large eces of material.

Let us now examine some of the pro-:ts under way in Britain. None, per-ıps, is as ambitious as that which Dr :nneth Shoulders is directing at Stan-rd Research Institute in California, in e hope of developing a data-processing stem that will pack 100,000 million mponents into a cubic inch. He aims use electron beams to machine thin ms into 10,000 million individual eas per square inch. He hopes to ve a prototype system ready in two ars' time. But work in Britain is none e less well advanced.

One investigation is being carried out Manchester University, on the appli-:ion of computer control to thin-film icro-circuit fabrication. The univer-y's Atlas computer will be used to ogram the complex machining opera-on to a high degree of accuracy — of e order of a quarter of a micro-tre.

The ultimate objective is the fabrica-n of a hundred passive elements (re-tors, interconnections, etc.) in an area e millimetre square — approximately uivalent to 70,000 per square inch. If ıe assumed a substrate 0.01-in ck, with suitable interconnections, s would represent a packing density seven million components per cubic :h.

Machining and drilling are not the ly possibilities in electron-beam tech-logy, however. The beam, when ghtly defocused, can also be used for lding. Since the welds are made in vacuum, without fluxes and on clean rfaces, their reliability and reproduci-ity should be high. The heat-treated ne is very small in area compared th conventional melting methods and ere is enough power in the beam to elt the most refractory metals.

Electron beams can also be used to ıke insulating films by polymerising a itable compound (see figure 4). Work being done at the British Scientific struments Research Association on electrics made in this way. Reactive e radicals are formed by the bom-rdment of the molecules with ener-tic electrons; indeed, the production contaminating films in this way has ubled electron microscopists for many ars. Dimethyl-siloxanes can be used the starting material and conventional cuum-deposition apparatus can be apted for the deposition of polymer ns by electron bombardment. The ulating properties of such films are ry good.

Ion beams, in which metal ions are used into a beam, can also be used micro-electronics; for example, they n be used to deposit extremely narrow es of copper and other metals. The ion source may consist of a molybdenum furnace in which a copper charge is vapourised and ionised by bombardment with electrons emitted from a tungsten filament. Metal ions are extracted through a small hole in the side of the furnace using a cylindrical extractor electrode in conjunction with a suitable lens focusing system.

Beams of 100 microamperes which contain a proportion of metal ions have been produced at the Electrical Research Association. In the U.S.A. it is reported that chromium resistor films have been deposited by similar methods, to form extremely small resistors.

It is also possible to fabricate narrow metal lines by chemically decomposing nickel carbonyl to give a nickel line, or chromium carbonyl to give a chromium line. An experimental apparatus for the purpose is shown in figure 5. In this case the heat in the beam is used to achieve decomposition of the carbonyl vapour at the surface of the substrate. Magnetic deflection can be used to deposit the line in the required circuit pattern. At the moment these lines are of the order of five micrometres wide, but by controlling the power and improving focusing of the beam much narrower lines should be possible.

Unfortunately, carbonyl vapour is

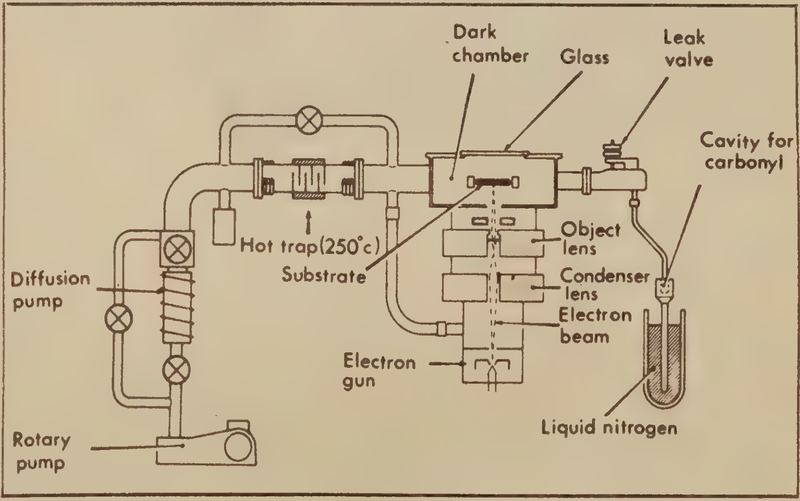
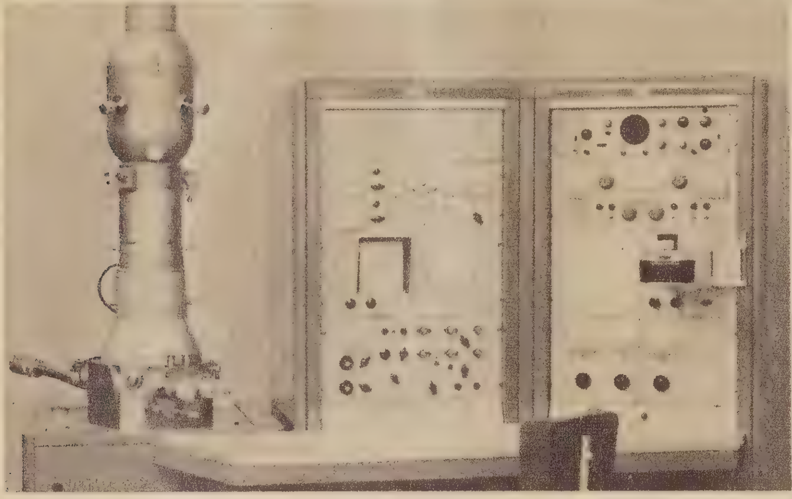


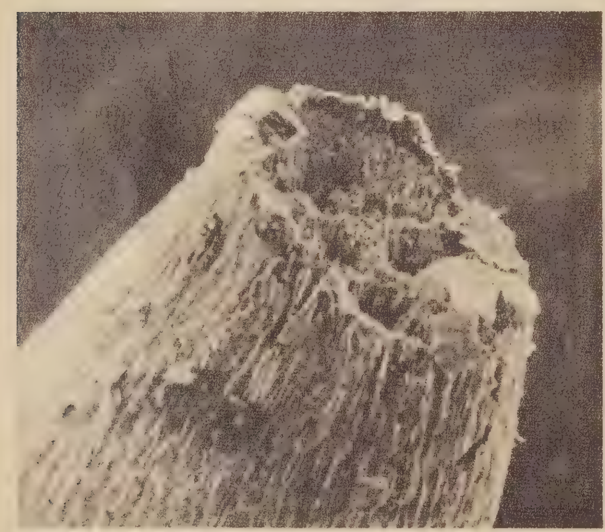
*Figure 5. Electron beam equipment developed at Royal Research Establishment for deposition from carbonyl vapours. This technique allows metallic films to be deposited by an electron beam.*

# SCANNING ELECTRON MICROSCOPE

One of the more recent developments in electron optics, the scanning electron microscope, has made possible sub-microscopic views of metal fractures, ceramics, and minute cavities, with a depth of field far in excess of anything previously possible.



*The scanning electron microscope. A visual display screen is provided on the left hand panel of the console and a photo recording system on the right hand panel.*



*An example of the scanning microscope's performance, showing a tensile fracture of a soft iron wire. Note particularly the extreme depth of field, the circular specimen being in sharp focus from front to back.*

Details 20 times smaller than th limit of optical microscopes can be displayed at the optimum performance o the device, called the Cambridge Stereoscan, but the great feature is that th depth of field is 300 times as great a that for optical microscopes.

The new micrographs look ver similar to an optical micrograph, except for the much greater depth of field Optical micrographs suffer from a ver restricted depth of field.

Stereographic "pairs" of pictures ca quite conveniently be made if necessary

The principle of operation combine complex television techniques with th now well-established techniques of electron microscopy.

A high velocity beam of electrons i scanned across the sample in a fine zigzag raster. When electrons imping on the surface of the specimen, whic is in a high vacuum, secondary electron are released from the surface.

The ejected secondary electrons ar collected, amplified, and used to control the brightness of the flying spot o a television tube which gives the resultant image.

The actual area scanned can b varied from 5 microns to 2mm square Useful range of direct magnifications i from 50x to 20,000x, which can be further magnified by photographic techniques. In terms of resolution this represents minimum detail size of 20 angstrom units, or 2 millionths of mm. Less than the maximum obtainable from the conventional electro microscopes by a factor of fou approximately.

Topographical detail can be show that is often unobtainable by any othe means. The instrument has alread proved invaluable in examining fractures in metallic, ceramic, and semiconductor materials, interiors of smal bore holes and capillaries, woven o unwoven fibres, paper and plastics surfaces, electrical and structural faults i microcircuits and transistors.

Low accelerating voltages down t 1KV can be used to examine insulatin substances, without the need for overlaying the specimen with a conductiv film.

The fact that specimens require virtually no preparation is another bi feature in favour of the process.

Based on the work of Professor C W. Oatley and his co-workers at Cambridge University, the Cambridge Instrument Co. say that the Stereoscan wil be further developed to take full advantage of the latest developments.

("Engineering News")

highly poisonous, and also colourless and odourless, so traps consisting of baffles heated to 250 deg. C. must be inserted between the diffusion pump and the workchamber, to render the apparatus safe to use.

Turning now to semiconductor integrated circuits, we find electron-beam technology has many possible applications. For example, silicon dice can be cut and shaped by electron-beam machining; fine gold wires can be welded to the silicon surface; gold can be selectively diffused into silicon so as to control the device's switching speed in a specific portion of an integrated circuit; and localised alloying of aluminium from a thin aluminium film evaporated on to a chip of silicon can be carried out to fabricate a matrix of diodes. Other applications are being developed, too, such as the fabrication of arrays of transistors smaller than can be made by the present "photolithographic" techniques.

The high-resolution scanning electron microscope is a device which permits examination of the surface of a solid specimen. A diagram of such a microscope is shown in figure 6. The electron beam, focused to approximately 0.01 micrometre diameter, scans the surface of the material like the beam in a television picture tube. Secondary electrons are knocked out of the surface by the primary beam and are collected by a scintillator-photomultiplier arrangement, the voltage from which is used to modulate the control grid of a cathode-ray tube scanned in synchronism with the electron beam in the main column. Th cathode-ray tube's image is photographe for a permanent record.

(See separate article, this page).

In micro-electronics, various applications of the scanning electron microscop are possible. For example, as the secondary electrons released from the specimen by the impact of the primary electron beam are collected, differences i voltage at the successive points of impac are revealed as differences in velocitie of the secondary electrons. This allow "voltage contrast" to be used for th examination of surfaces—in particula those of silicon integrated circuits. Th method can reveal junctions, breaks an other faults in conductors, for example or voltage gradients along resistors. Th procedure is non-destructive and more

## HE LUX SQ11 . . . AUSTRALIA'S MOST POPULAR SOLID STATE STEREO AMPLIFIER

Users everywhere report excellent performnce with this fully transistorised stereo mplifier. Input sensitivity is 4mV, output s 20 watts in each channel. Features include: oudness control, scratch and rumble filters, eparate bass and treble controls, tc. Send for full details. Simiar quality is usually tw.ce th.s rice. **$139**

### TAPE RECORDERS

Advertising our prices for tape recorders is forbidden by trade associations—but we're selling plenty! Stock includes: Revox, Tandberg, Beo-Cord, Akai, Sony, National, Philips, Ferguson, Truvox, Grundig, etc. Decks include Grundig, Sony and Collaro. Write for EMQ's—and see the Encel 12-page feature in this issue.

### KEF SPEAKERS

The new KEF "Celeste" with the improved "Super-tweeter" is now in stock. HF performance is considerably improved with this new tweeter. Write for an EMQ now on the new model KEF "Celeste."

### ACOUSTECH AMPLIFIERS

Acoustech equipment is regarded as the finest in the world—leading international reviewers use Acoustech in their personal equipment. The first shipment sold out quickly! Write for prices and technical specifications.

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This popular stereo amplifier incorporates a built-in AM and FM Multiplex. Write for an EMQ and specifications.

### ENCEL WAREHOUSE STOCKS INCLUDE:—

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Ortofon, ADC, SME, Shure, All Balance, JH, Pritchard, etc.

#### TURNTABLES

Orpheus, Labcraft, Garrard, P.E., Lenco, Thorens, J.H., Dual, etc.

### ENCEL X1212 STEREO AMPLIFIER

The new Model X1212 features an input sens. of 4mV, an output of 12 watts RMS in each channel and a frequency response of 30—50,000 c/s. Although many improvements have been incorporated, the price is now only .. .. .. .. .. .. .. **$85**

### UNIQUE ENCEL STEREO SYSTEM WITH 5 SPEAKER ENCLOSURES

If you wish to purchase a complete stereo system at budget rates, this outstanding offer must interest you. Included are the Star SA30 stereo amplifier — 10 watts RMS each channel, Labcraft 643 turntable fitted with B and O stereo diamond magnetic cartridge, two "Encel-ette" 5 speaker systems with oiled walnut or teak cabinets. Each speaker system employs four 6½in speakers and one 2½in tweeter .. .. .. .. .. .. .. .. .. .. **$190**

**(The new model Encel X1212 stereo amplifier may be substituted for the SA30 without additional cost.)**

### PHILIPS MASTER RANGE SPEAKERS

All models now available. Minuette, Minstrel and Majestic. Write for EMO's.

### NEW CELESTION TWEETER UNIT

The Celestion HF1300 tweeter is now available in Australia. This unit is a development of the GEC BSC 1852 . . . which needs no introduction to hi-fi enthusiasts. Frequency response is level within plus or minus 2db from 1500 c/s to 13 kc/s and extends well over 15 kc/s. Ratings quoted are conservative. Simply connected via a 10 mfd capacitor supplied free of charge .. .. **$15**

## *NEW SYDNEY STORE NOW OPEN!*

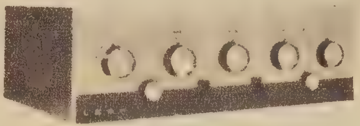
Encel Electronics' Sydney store is now open . . . conveniently situated on the Ground Floor, 2SM Building, 257 Clarence Street. Here is a veritable Aladdin's Cave of audio equipment, tape recorders, etc. . . . including many exclusive Encel lines **not available elsewhere** in Sydney.

### KELLY SPEAKERS

Now a subsidiary of the Decca group, Kelly has increased production to satisfy ever-increasing world-wide demand. The Kelly Mk. X Ribbon Tweeter is more popular than ever at the Encel price of $39. The New Acoustic Lens for the tweeter is now in stock —price $10. Kelly has also released a new bass speaker—the 12in Mk. V. Total flux is 250,000 maxwells—resonance 25 c/s. Price $45. Crossover to match, $11. See the 12-page Encel feature for full details.

### WHAT IS AN EMQ!

Many prices cannot be advertised because of trade agreements, so we advise you to write for an EMQ . . . an Encel Mail Quote. When asking for prices on amplifiers and tape recorders, please specify features required. Combinations of any components are possible —simply tell us of your requirements. Please supply your FULL ADDRESS in BLOCK LETTERS.



### BUY YOUR "STEREO 30" NOW!

Encel trade-in prices on this remarkable LEAK amplifier are at their peak . . . so write now for an EMQ or a trade-in valuation.

### TOP VALUE STEREO SYSTEM

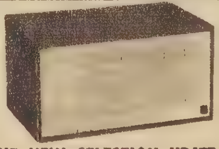
Linmark SA2000 stereo amplifier, Labcraft 643 Turntable with B and O magnetic diamond cartridge, two Wharfedale 8in RS/DD wide-range speakers .. .. .. .. .. **$138**

### SPEEDY MAIL ORDER SERVICE

When ordering, please give your full address printed in BLOCK LETTERS. All Encel equipment is brand new and fully guaranteed. Sales-tax is included in Encel prices. We care-pack and freight anywhere! In Melbourne, a special Encel Service Centre is situated at 361 Bridge Road, Richmond—in Sydney service is available through the Encel Centre at 257 Clarence Street.

### INTERCOMMUNICATION SYSTEMS

Several models available. "Eden" 7 station — $35.50. "Eden" 4 station—$27.50. "Gem" 3 station—$11.50. "Gem" 2 station—$9.50. Well-known "Fountain" systems 7 station—$44.20. 4 station—$27.10. 2 station—$14.10.



### THE NEW CELESTION "DITTON 10"

Regarded as one of the most advanced compact speaker systems ever to be released, the Celestion Ditton 10 is available in either teak or walnut oiled finishes. Frequency response is conservatively quoted at 35-15,000 c/s. See the reviews in "Electronics Australia," p. 131, Dec. 65; "Hi-Fi News," p. 433, Oct., 65; "Gramophone," p. 41, June 65. Size of the Ditton is only 12¾in x 6¾in x 8¼in. Encel price .. .. .. .. .. .. .. .. **$59**

### CAMERAS AND PROJECTORS

Encel Electronics now carries a fine range of photographic equipment. All equipment is brand new and guaranteed. Ask for an EMQ on the best-known makes of cameras and projectors. Sorry, no phone quotes . . . trade associations do not approve!

### CELESTION "STUDIO SERIES" SPEAKERS

Both Celestion coaxial 12" models are proving very popular in Australia . . . and the price is more than competitive. The Standard Model CX1512 has a conservatively quoted frequency response of 30-15,000 c/s and is rated at 15 watts RMS. The Deluxe Model CX2012 (illustrated) has a frequency response conservatively quoted at 30-18,000 c/s and is rated at 20 watts RMS. Both models employ pressure type tweeters and feature an electrical crossover at 4 kc/s. See the reviews in "Electronics Australia," p. 131, Dec., 65; "Gramophone," p. 511, April, '65; "Hi-Fi News," p. 75, June '65.

#### ENCEL PRICES

| | |
|---|---|
| Standard CX 1512 .. .. .. .. .. .. .. | $39.50 |
| Deluxe CX 2012 .. .. .. .. .. .. .. | $59.00 |

Cabinet construction details are available on request.

## EXCLUSIVE ENCEL OFFERS FOR JUNE

**1** Mullard 6GW8 4 watts per channel stereo amplifier. Labcraft 643 turntable with with stereo diamond cartridge two 8in Wharfedale speakers. An ideal budget system. Price .. **$110**

**2** The new Encel X1212 or the Star SA30 stereo amplifier, Labcraft 605 turntable, J.H. tone arm, ADC 770 stereo diamond magnetic cartridge, two twin-cone 10in Wharfedale RS/DD speakers. (10in Stentorian / Richard Allen speakers at the same price) .. **$187**

*With the Sony TC 250a stereo tape deck (2 speeds) fitted with recording and playback amplifiers. Price .. .. .. .. .. .. .. .. .. **$328**

* Supplied with Grundig TM45 3-speed, 3-head stereo tape deck (fitted with recording and playback amplifiers as used in the TK46). Price .. .. .. .. **$348**

**3** Pioneer SMB 161 stereophonic amplifier with AM/AM/SW tuners, Labcraft 643 turntable with B and O stereo diamond magnetic cartridge. Two Wharfedale 8in RS/DD speakers. Price .. .. .. .. **$210**

(Save **$30** by using the Roland FAX 150 amplifier. If you prefer the Labcraft 605 turntable, All Balance arm and ADC 770 cartridge, **add $20.**)

**4** Leak Stereo 30 amplifier, Orpheus Silex turntable, ADC 40 tone arm, ADC .4E cartridge, two Celestion CX 2012 co - axial speakers. Price .. .. .. .. .. .. .. **$438**

**5** Pioneer 204B Stereophonic amplifier with AM/AM/FM/SW tuners, Orpheus Silex turntable, Ortofon SMG 212 tone arm, Ortofon SPU-GT-E cartridge, two Celestion CX1512 speakers. Price .. .. .. .. .. .. .. .. **$345**

**6** Two Wharfedale Linton speaker systems, Labcraft 605 turntable. All Balance tone arm and ADC 770 cartridge. **$215**

**7** Orpheus Silex turntable, Pritchard tone arm, ADC 10 E cartridge. Price .. .. .. .. .. .. .. .. **$137**

**8** Sansui Model 220 stereophonic amplifier with AM/FM/SW tuners, Dual 1000 turntable. ADC 770 cartridge, two Wharfedale 10 RS/DD speakers. Price .. .. .. .. .. .. .. .. **$278**

*Make up your own combinations and ask for an EMQ!*

### EARLY ENCEL SPECIALS AVAILABLE

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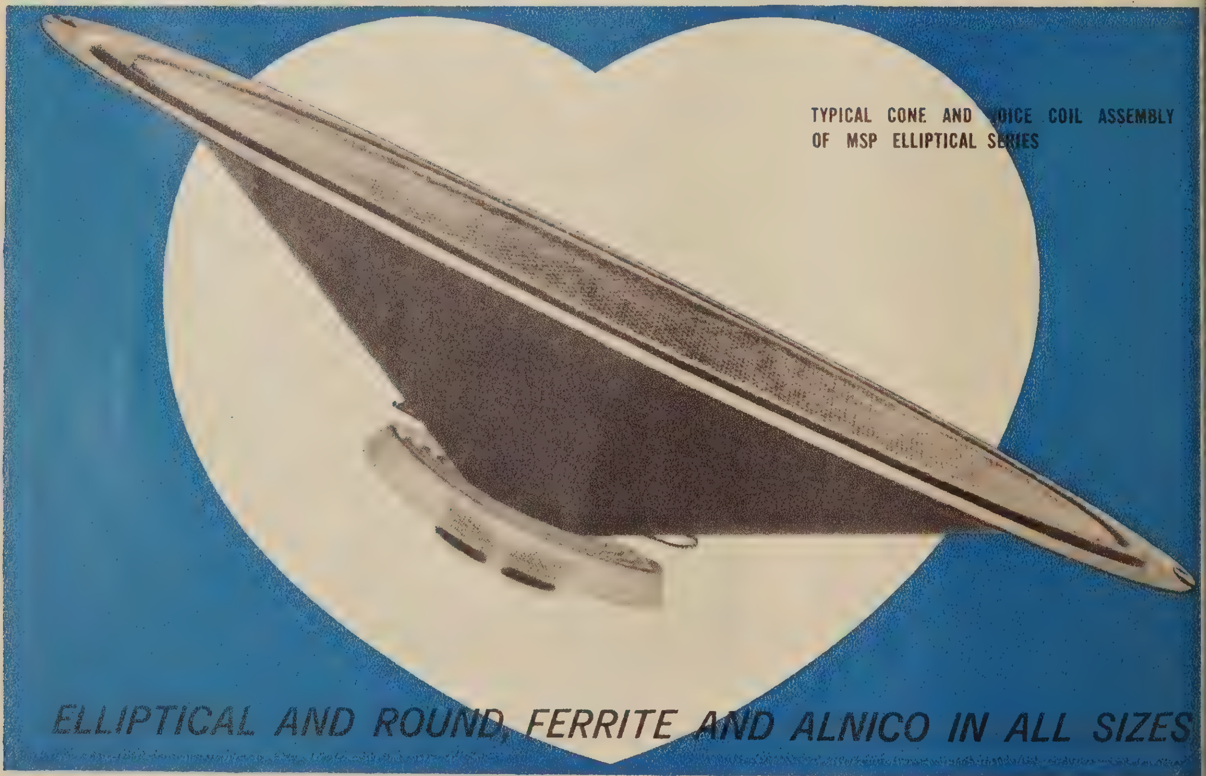

TYPICAL CONE AND VOICE COIL ASSEMBLY OF MSP ELLIPTICAL SERIES

Kid gloves are not good enough for the handling of this **key** component of every MSP Hi-Flux Speaker — from the moment the **cone** is formed it is treated with meticulous care as it proceeds through an exacting series of tests and inspections. But the greatest care of all begins at the design stage when the exact cone shape and rim configuration are determined. Then comes the choice and blending of fibrous pulps for the sound characteristics to be achieved — next to be decided is the most suitable beating cycle which will turn the mix into the exact form required — then follows the decisive cone forming operation — bu perhaps enough has been said alread to convince you that MSP speake cone design and manufacturing techniques are important reasons why this range has become **first choice** i Australia.

**MANUFACTURERS SPECIAL PRODUCTS PTY. LTD.**
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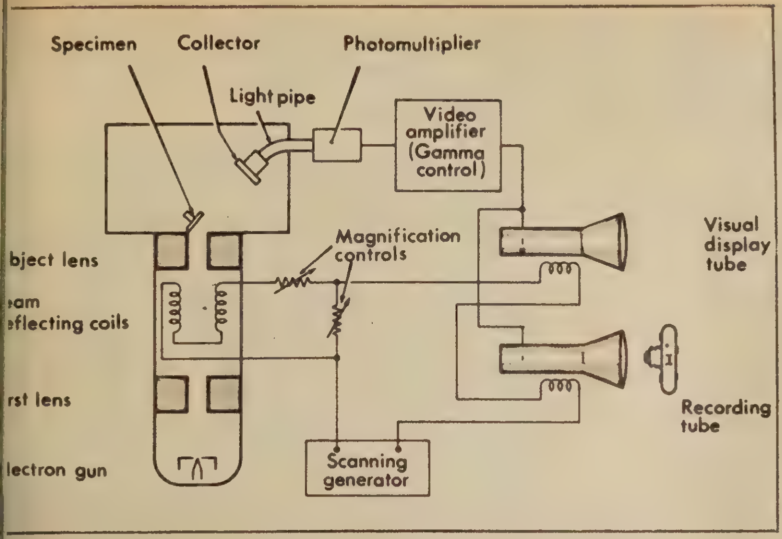

*Figure 6. The main features of a scanning electron microscope. (See also pictures on page 14.) In addition to checking the actual physical structure, it can also reveal "voltage contrast" such as voltage gradients along resistors, or breaks in conductors.*

ver can often reveal features concealed eneath oxide layers.

The scanning electron microscope an also be used as a machine tool for icro-electronic devices. In particular can be used in a variation of the well-nown "photo-resist" method, in which arts of the surface of a material are rotected by a material that has been posed to light while the remainder is ched away. At Cambridge University resist pattern has been "written" with 0.01-micrometre electron probe and e sample then etched with a beam of rgon ions.

Two kinds of resist have been used: licone-oil molecules from the vacuum ystem, which were polymerised by the ectron beam, and the standard photo-sist KPR. With silicone-oil, films of old 0.4 micrometres thick on glass or licon can be machined to an accuracy f 0.075 micrometres; with a thinner old film only 500 angstroms thick, a omewhat higher resolution is possible. PR gives much better "writing" speeds ut the resolution is poorer.

I believe the time is now opportune combine these various techniques in n attempt to fabricate working circuits. lthough techniques now exist for fabri-ating minute resistors, capacitors and elded connections, the main unsolved roblem is the fabrication of the active" elements like diodes and trans-tors. It would seem that one of the ost promising approaches would be to abricate what are known as "field-ffect" triodes (FETs).

Already metal-oxide semi-conductor ansistors (MOSTs) have been fabri-ated by conventional photo-etching chniques to approach packing densities f 10,000 per square inch. With the ew techniques we are on the way owards densities of 100,000 per square ich. One of the most difficult prob-ms which will have to be faced is that f interconnections. This has already ecome a problem in micro-electronic rrays of devices and will be many mes more difficult with even higher acking densities.

It is clear, then, that electron and ion eam methods of fabrication afford nmense scope for further progress in electronics. Although themselves not yet in widespread use, the present-day micro-electronic methods may be followed by "nano-electronic" and even "pico-electronic" methods of fabrication ("micro" means $10^{-6}$, "nano" $10^{-9}$, "pico" $10^{-12}$). But I must emphasise that these very advanced techniques are still many years from commercial practice and, in the meantime, a great deal more fundamental work has to be done.

An interesting thought with which to conclude is that a surgical operation may some day be able to fit a "pico-electronic" computer on a man's head to augment the computing and storage capacity of the human brain itself, creating in effect a "superbrain." ■

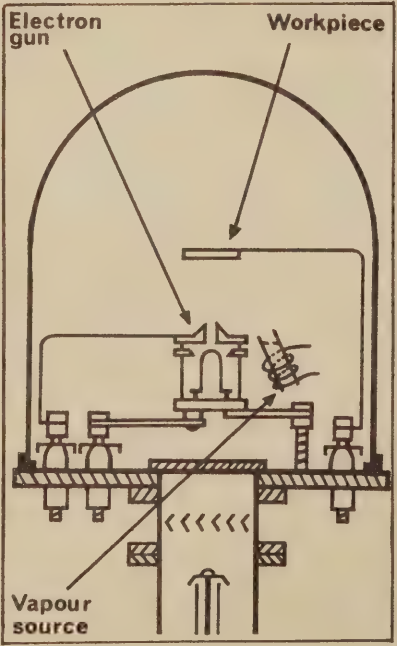

*Figure 4. Apparatus for the deposition of polymer insulation films by electron bombardment.*

## RURAL RADIO TELEPHONES

**Experiments now being conducted in the Winchelsea area of Western Victoria may eventually lead to cheap radio-telephone services in Australian rural areas.**

The experiments are being conducted by the Post Office research laboratories. The object it to provide telephone services in rural areas by radio instead of the conventional wire line so far used.

Formerly the provision of a radio telephone service for rural subscribers was impracticable because of the high power requirements, warm-up delay, and poor reliability of the valve-type equipment available. Recently, however, fully transistorised telephone equipment has become available.

At the Winchelsea telephone exchange a radio base station has been established. It interworks with two outlying farm residences several miles from the exchange. At each there is a modified standard telephone associated with radio transmitter and receiver and an external TV-type aerial.

The experimental equipment provides a party line telephone service similar in principle to those existing in other rural areas of Australia. Further developments, if trials prove encouraging, could lead to the provision of exclusive and automatic services.

The equipment has no warm-up delay and the normal power supply available at most farm houses is quite adequate.

Apart from the potential economic and performance advantages, the technique is less subject to interruption through emergency situations such as storm, fire or flood.

With the rapidly spreading use of mobile radio telephony in larger private enterprise, public utilities and Government departments, one of the most serious factors to be considered is the increasing congestion in the radio-frequency bands available for such purposes.

For extensive applications in rural areas it is expected that it will be necessary to employ radio frequencies well above the commonly used 80, 160 and 450MC bands. Development of simple radio equipment operating in the 900MC band and higher has commenced.

In the Winchelsea experiment the subscribers are given all the usual facilities normally provided with rural party lines except that it is necessary to operate the equipment in a "press-to-talk" way for conversations between parties on the same party line.

It is possible to eliminate the press-to-talk feature by providing a relatively small amount of additional equipment, and it is intended to install a trial system of this nature later this year at a suitable location in western New South Wales.

# PLESSEY

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- ☐ potentiometers
- ☐ professional tape recording equipment
- ☐ pick-up cartridges
- ☐ record playing equipment
- ☐ television deflection components
- ☐ subminiature valves & neon lamps
- ☐ power capacitor equipment
- ☐ resistors-carbon, wire wound & metal film
- ☐ power rheostats
- ☐ relays
- ☐ rotary solenoids
- ☐ timing & regulating devices
- ☐ transformers & inductors
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# MANHUNT—Aerospace Style

This story from a recent issue of the "Boeing Magazine" caught our eye. It indicates the opportunities open to graduates in U.S. industry, but equally it highlights the initiative shown by some big companies to recruit the men (and women) they need to continue their huge programs of development and manufacture.

Recruitment of graduates and skilled echnical staff to take part in the inreasing technological development of he great labour-hungry industrial comlexes in the U.S.A. is taking on more nd more the character of a "hard sell," vith added inducements outside the ormal industrial activity.

The manhunt, obvious in the classified dvertising pages of any city newspaper r the burgeoning aerospace trade publiations, is both the symbol and the reult of United States progress in building aeroplanes, spacecraft, helicopters, ydrofoil boats, missiles and associated roducts. No recruitment effort pproaching this one in size has ocurred since World War II and even hose years offer no comparison n the need for skills. Virtually every erospace company is involved, along vith many other industries.

The Boeing situation is fairly typical. he company's interests range from pace vehicles to hydrofoil boats. It as undertaken multiplied production of elicopters for use of the armed forces n Vietnam, is meeting increased reponsibilities for the Saturn V booster nd associated systems and is preparng for launching of the Lunar Orbitr. Now working on modernisation of inuteman missile complexes and comleting preliminary studies of a shortange air-to-ground missile (SRAM), he company competes actively in most f the nation's space programs and ontinues its independent research fforts in a dozen disciplines.

Success of the Boeing family of comercial jet airliners has resulted swelling orders for existing models nd in expansion of the line to include he two-engine short-to-medium-range 37. Other new models are being conidered and maximum effort is eing made to win a contract to build n American supersonic jetliner.

All this has required company-wide xpansion of facilities — a $20 million pace centre at Kent, Washington; buildgs at Huntsville, Alabama; manuacturing complexes and laboratories at enton, Washington; a 400 per cent ince 1960) expansion of facilities for e Vertol (helicopter) division in Pennlvania; a central fabrication plant at uburn, Washington; final assembly uildings in Seattle. The program inolves commitment of more than $250illion in the Western Washington area lone, plus comparable expenditures lsewhere.

Such programs demand intensive arch for engineers, scientists, techniians, computer experts, metallurgists, achinists and other skilled persons. ince so many companies have somehat similar needs, this search is highly mpetitive. For Boeing, this involves the establishment of employment offices in Spokane and Tacoma, Washington; Portland, Oregon; Minneapolis, Chicago, Detroit, New York, San Francisco, Phoenix and Houston. These are served by resident staffs and also are used by travelling recruiters making periodic visits to these areas.

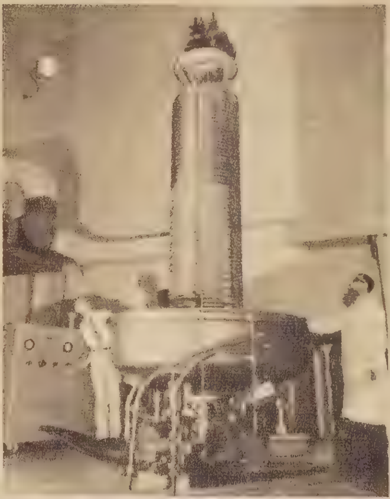
Company officers have pointed out publicly the company's need for 4,000 additional engineers and technicians in the Western Washington area alone during the next year — plus 11,000 other new employees. Other Boeing industrial sites have smaller but equally important needs.

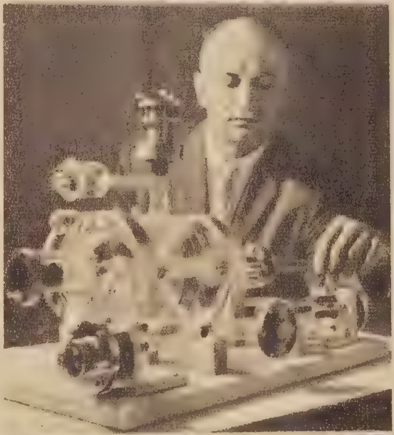
In one very specialised science American colleges this year are expected to graduate about 200 students. Only about half these graduates will hold degrees from schools with standards universally approved. Of the 100 thus especially useful to their profession, approximately 50 have a preference for the academic life and do not welcome industrial jobs. For the remaining 50, every space-oriented company in the country is competing—and there are at least a dozen of them actively doing so.

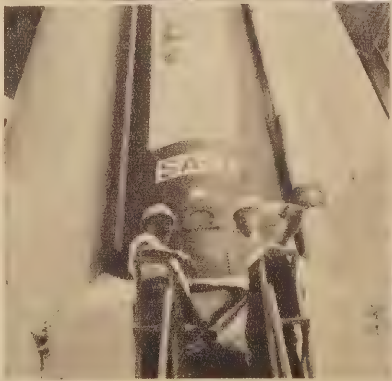
Thus it is understandable that Boeing, like its competitors, is pushing its efforts at college recruitment. More than 180 campuses, including 13 in Canada, will be visited during the school year and 6,000 students will be interviewed. Teams of recruiters are on the road right now, interviewing students who will be ready to go to work in June. This is a continuation of a program of cooperation with the colleges which has been in operation for many years.

Boeing recruiting teams usually are made up both of line supervisors and personnel men trained for the assignment. They know the work and the job opportunities and can give first-hand answers to practically any question asked.

The placement director at each college arranges schedules so that each company has an equal chance to interview graduating seniors. A list of companies sending interviewers is posted on bulletin boards and promoted in other







*The manifold activities of the Boeing company provide opportunities in many specialised fields for skilled staff. These pictures, representing only a few facets of the range of Boeing activities, show (top to bottom) a Dynamitron in use in the Radiation Effects Laboratory; experimental equipment under development; preparing a missile for launching at Cape Kennedy; and (right) launching a balloon for cosmic ray study.*

Peter Clark of Magnetic Sound,
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The National 755 makes stereo taping so alive it almost comes out and touches you. The rich, clear, vibrant reproduction has made this machine one of the best selling tape recorders in the world. 2 channel stereo or mono, 4-tracks, 2 speeds, 2 inbuilt speakers, double recording. List price $304.50.

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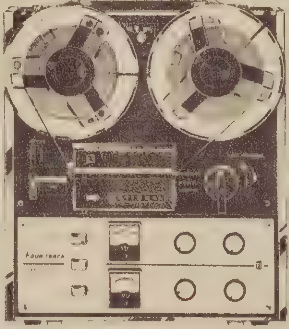

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ways on each campus. Students
briefed on how to conduct their
of the interviews to make the best
pression and get the information
desire.

Publications such as BOEING M
AZINE and brochures describing k
of work and opportunities are avail
in college libraries to enable stud
to learn something of the various c
panies which may wish to offer t
a position.

Interview rooms at the univers
now are busy nearly all day long. M
interviews last one half - hour e
Before an interview an intere
student fills out an application. At
time of the interview the recru
finishes his evaluation of the stud

Boeing’s aim is to do the
possible job of matching an intere
student to a suitable position. As s
as possible after an interview the
dent will hear from Boeing by
phone, telegram or letter if an
is to be made. If not, he also wil
informed. In some cases a studen
invited to visit a Boeing plant
further interviews.

College recruiting isn’t limited
engineering and science students. B
ness administration graduates, for
ample, are much in demand.

The present recruiting campaig
aimed primarily at the June gradu
Another recruiting period will b
early in October. This will be aime
mid-year graduates and those stud
who have been working on adva
degrees.

As part of their plan to present
best case to wanted staff, companies
Boeing take careful stock of the nat
advantages, as well as the special
ditions they can offer prospective
ployees. With establishments wi
separated in different States over
face of America, they can offer a r
of living locations with widely diffe
topographical conditions, where a
can set up home in an area which
cater for his recreations and out-of-w
interests, whether his tastes are for
outdoor life of hunting, fishing, boa
or just plain looking at Nature; or
the man-made pleasures of the
nightclubs, concert hall and o
attractions of the big cities.

Naturally, recruiting efforts em
sise first the opportunities available,
excitement of the various projects,
chance for advancement and to be
volved in the most modern design
grams. But most companies empha
such advantages, match wages
working conditions and the prospe
employee might have difficulty in
sessing their advantages.

Some prospective employees m
feel attracted to the Boeing plant in
Orleans, where a man who likes b
labaisse can get the best in the w
Or if he’s a history buff, Boe
Morton helicopter people can poin
nearby Philadelphia, and Boeing’s m
rocket men to Huntsville and
Florida Coast, where history oozes
of the walls. And if his principal
terest is good schools, Wichita
Seattle can vie with statistics.

If the prospective employee
scenery, fishing, moderate weather
a spot of forest—well, he gets
certain, a Washington State broch
Sometimes, a company just can’t
a better ally than a few million trees.

# Technical Review

## OPERATING PRINCIPLES OF METAL LOCATORS

From time to time, inquiries are received from readers about metal detectors. A recent article in the American magazine "Radio-Electronics" gave a brief description of the principles involved in three types of metal detector, and is reproduced here for the benefit of interested readers.

A police department called on a metal locator to find, in four inches of trampled snow, a spent bullet that figured in a murder case. A refinery used a locator to stake out a dogleg run of buried feeder conduit that blew out in a power surge. A contractor likes to use a locator to sweep for known and unknown gas, water and telephone lines ahead of his digging machines. Each job needed a different type of instrument, handled in a different way. There are three types of metal locators in common use.

The search-coil type (figure 1), commercialised from the wartime mine detector, is best at finding small bits of metal not buried very deep.

Its coil, worked in a horizontal plane near the ground, is a field-sensitive component in a Hughes balance circuit. The frequency is usually between 20 and 100KC.

The pickup and oscillator coils are mounted in the detector head and oriented so there is no signal transfer from the oscillator to the receiver coil when there is no metal in the vicinity. The receiver is a straight RF amplifier-detector with a couple of stages of audio amplification. As the coil is brought nearer to a piece of metal, or any material more conductive than the soil, the operator hears a rising beat note in his headset.

You can expect excellent work within a bowl-shaped range to a depth of about the radius of the search coil, falling off to good at the diameter of the coil, and usable results under favourable conditions to two or three feet with a 10-inch coil.

The RF transmitter-receiver (figure 2) needs bigger stuff to work with, but will oblige with a depth range from 6ft to 20ft or more under best conditions.

Used in the petroleum industries as a pipe locator, one of these consists of separate transmitter and receiver units tuned to each other at a frequency between 20 and 100KC through built-in loop coils. The working principle is to transmit a signal into or toward any buried stuff and then pick it up with the receiver as a beat note of audio frequency.

Three arrangements are possible with the same instrument. For a one-man search unit, the transmitter and receiver may be clipped in a mutual null position on a carrying shaft so that only reflected or secondary signals from the transmitter can be picked up by the receiver. Or the transmitter may be carried or set down over one point of a buried pipe or cable while the receiver, 20 to 100ft away, is used to locate the pipe's course with an accuracy of a few inches. In a third method, the transmitter may have a switch to send the signal to a terminal post which can be wired to an accessible part of the otherwise buried pipe or what-have-you.

The AF transmitter-receiver (figure 3) is also known as a pipe locator. The receiver is simply a very uncomplicated audio amplifier whose pickup may be a search coil of a few hundred turns on a 6 to 12in form. The transmitter is generally a vibrator or sine-wave generator

(Continued on Page 25)

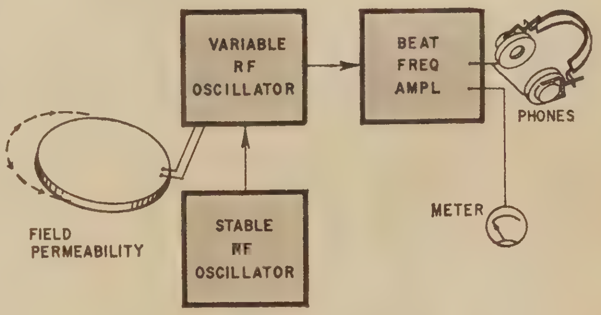


*Figure 1*

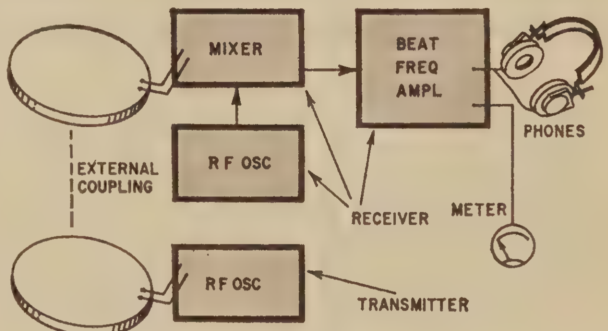


*Figure 2*

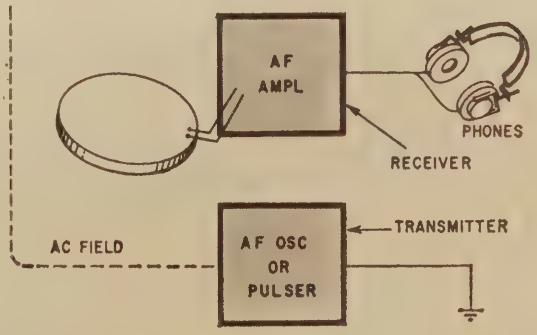
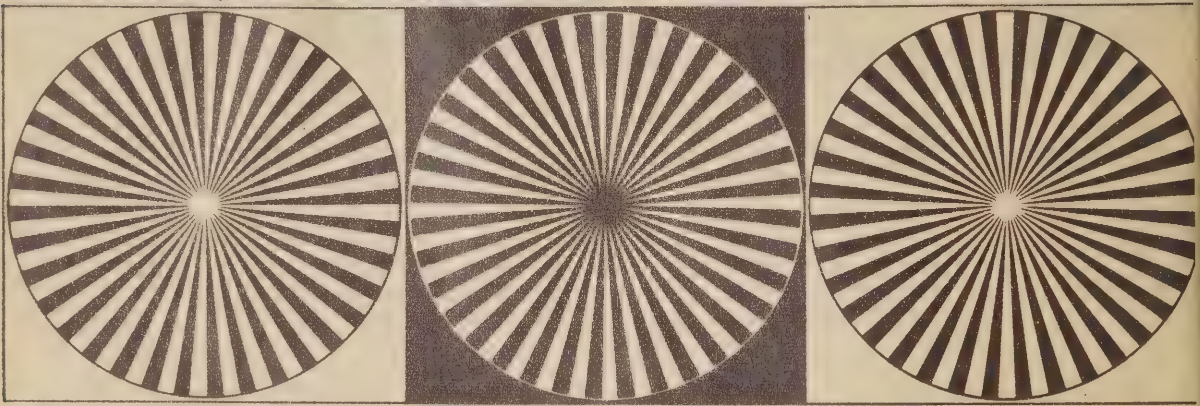


*Figure 3*

Eliminate localized



heating and melting

New 1.5-amp rectifier dissipates up to 1000 watts in reverse direction without heat damage

The new General Electric A-14 is a 1.5-ampere, glass-encapsulated rectifier that instantly absorbs voltage transients generated by household or industrial power lines. It dissipates up to 1000 watts in the reverse direction without damage.

General Electric engineers recommend the A-14 for most low-current power-rectifier sockets: time-delay circuits, battery chargers, communication equipment, small portable appliances and general-purpose power supplies. The "A-14" designation covers four devices, rated from 200 volts to 800 volts.

General Electric uses controlled-resistivity silicon metal for pellet fabrication. The pellet is securely sandwiched between two heavily thermally-matched slugs, which draw heat from the pellet out to the high-conductivity copper-alloy leads. When a transient voltage appears across this new G-E rectifier, its PN junction goes into reverse avalanche breakdown, distributing the reverse power uniformly and safely *throughout the bulk of the silicon pellet.* This prevents localized heating at the perimeter—the kind of heating that impairs or destroys the blocking ability of a convential rectifier.

The A-14 is packaged in glass, eliminating internal cavities which can act as a potential source of moisture or contamination on the junction. The temperature coefficient of the glass is matched with the internal parts of the A-14.

For full information on the A-14 series, contact Australian General Electric Pty. Ltd., 103 York Street, Sydney. 29-8711. 552 Lonsdale Street, Melbourne. 67-8221.

GENERAL ELECTRIC

# CAN COMPUTERS ARRANGE SUCCESSFUL MARRIAGES?

Marriage is often termed "a chancy business" and attempts to place the selection of a life partner on a rational basis have met with only limited success. In U.S.A. and some European countries, computers are now being used to try to ensure that a man or woman looking for a spouse meets somebody whose temperament is compatible with their own. The big question is — can electronics "match" couples better than they can match themselves? The subject was examined in the March, 1966, issue of "Popular Electronics," from which the following is extracted.

Declares a leading marriage counellor, "With nearly one marriage in very four ending in divorce, it would eem that almost any scientific method –including an electronic one—would be referable to merely letting nature take ts course."

Does electronic matchmaking really et results—lasting results?

Candidly concedes an electronic matchmaker. "No 'electronic matching' psychologist or agency, regardless of cientific standing, has been operating ong enough — few have been in the business' even a dozen years, and most ot nearly that long — to be able to alidate its tests on the basis of proven performance: lasting and happy mariages."

In an era when electronics is probing he depths of the human mind and body, can it go one giant step further: educe to definables that hitherto undeinable — love?

"Electronics," says one expert, "isn't concerned with love. It's concerned only with compatibility. More correctly, with he myriad of psychological factors which gauge and measure compatibility. When a computer 'matches' two people, t makes only one claim; insofar as psychological testing can determine, these wo are compatible. Psychologically, hey're suited for one another. If the chemistry is there — if they also happen o fall in love — the probability for a successful marriage is high."

Finally, how advanced are the elecronics of matchmaking?

"Technically speaking, the electronics are close to infallible," declares a computer technician. "But that's more than you can say for some of the data fed the computers and punch card sorters. 'Programmed' introductions can be only as good as the programmer . . . and only as valid as the psychological tests used as a basis for programming."

Continues this technician, "For thousands of people, there's big magic in computerised courtship . . . in the very idea that an electronic gadget, sight unseen, can, you might say, deliver up a soul-mate . . . and, just maybe, lifelong ove and happiness."

Manhattan's Scientific Marriage Institute, Inc., founded about 10 years ago by two sociologists, Miss Lee Morgan, M.A., and Eric Riss, PhD, now its executive director, claims that about 35 per cent of its clients (as many as 300 new clients apply each week, says Dr Riss, triple the number a few years back) find marriage through electronics. "But," warns Dr Riss, "there's certainly no magic in electronics."

As is the case with some other electronic matchmakers, SMI doesn't yet use a computer, although it does employ electronics — an IBM 82 punch card sorter. Your test results, reduced to a punch card, are "matched" by the machine with cards of other marriage hopefuls in SMI's files. If the machine's first pick doesn't turn out to be "Mr Right" (or "Miss Right," as the case may be), your master card is matched again —and again, an introduction. In all, an applicant can expect about 12 "qualified" introductions.

Scientific Marriage Foundation, Mellott, Indiana, is among the oldest (now in its ninth year), most marriage-productive (it claims to have "produced" some 10,000 marriages), and lowest in cost of computerised matchmakers. Founded by Dr George W. Crane, an M.D., a practising psychiatrist and author, the foundation in Dr Crane's words, is "a non-profit social project."

Dr Crane is plainly proud of results. "Our divorce rate," he told the author, "is only 10 —10 divorces after nine years of operation, which means just 1/10th of 1 per cent . . . in contrast to (a divorce rate of )about 30 per cent or even worse for the nation at large."

Scientific Marriage Foundation operates in all 50 States and Canada, relying on some 3,000 clergymen (of all major faiths) to "do the personal interviewing of applicants." The resulting data, reduced to 10 "compatibility" factors, is fed to an IBM 101 statistical tabulator. "Matched" couples are introduced by mail and after some correspondence, are encouraged to meet.

Michigan Scientific Introduction Service, Inc., Ann Arbor, Mich., perhaps the third largest of the computerised mate-finders, "pairs" prospective couples much as do the others — by tests and questionaires, amasses some 150 key facts and from these matches likely marriage partners. Men get the names, addresses and phone numbers of their female compatibles and are supposed to take it from there.

In Germany where professional matchmaking (with or without a computer) has been popular since the Middle-Ages — and more so today, with frauleins vastly outnumbering men —many of Germany's 260 professional matchmakers have turned to electronics.

Hamburg's Altman Institute, for example, puts hopeful brides and grooms through a four-page psychological quiz and a personality "colour test," then feeds this data to a computer.

Computerised matchmaking has captured the imagination of millions of young Germans, many of whom leave school at 15 and, thereafter, have a hard time meeting suitable marriage partners. Whereas U.S. teenagers and young adults rendezvous at local drive-ins or bowling alleys, a growing number of young Germans head for a computerised matchmaker. German matefinders say the majority of their husband hunting clients are in their twenties (often early twenties), the men in their thirties. By contrast, some American electronic "mating" services complain that they're "overloaded with over-40 divorcees and and near-50 bachelors."

A German marriage-initiator states, "There's no stigma to meeting by electronics in this country. How could there be when brokers, often with the aid of computers, arrange 60,000 to 80,000 marriages every year?"

By contrast, many "computerised" American couples confess to "embarrassment" at having met by electronics. Hundreds of electronic couples hide the circumstances of their meeting from friends and relatives. Most U.S. "mating" agencies advertise, "All correspondence in plain, white envelopes."

Almost as clandestine are the American computer makers themselves. An IBM spokesman in Los Angeles, squeamish at the use of IBM's machines in courtship, parried all questions with a curt, "Go ask Sperry-Rand." Another computer maker's representative put it just as bluntly, "We don't encourage our computers being put to this use. Our feeling is that whatever the findings, they're far too statistical . . . just a surface reading which misses the mark in psychological depth perception."

This view seems to be borne out in some instances, and there seems to be a measure of agreement that some computer agencies are worthless. Some produce results that are ludicrous.

Consider the 26-year-old stenographer —pretty and personable by any reckoning — who describes the six men dredged up by a computer as "the saddest collection of misfits and oddballs I've ever met. If that's the computer's judgment of me, then I've been overrating myself for years."

Such disheartening results aren't the fault of electronics. The fault lies with the clientele. One electronic matchmaker admits that the "average" age of his female applicants is 38 and that fully "80 per cent have been previously married" (meaning, they're divorcees). The average male on his roster is 40 (and 60 per cent of these males have never been wed).

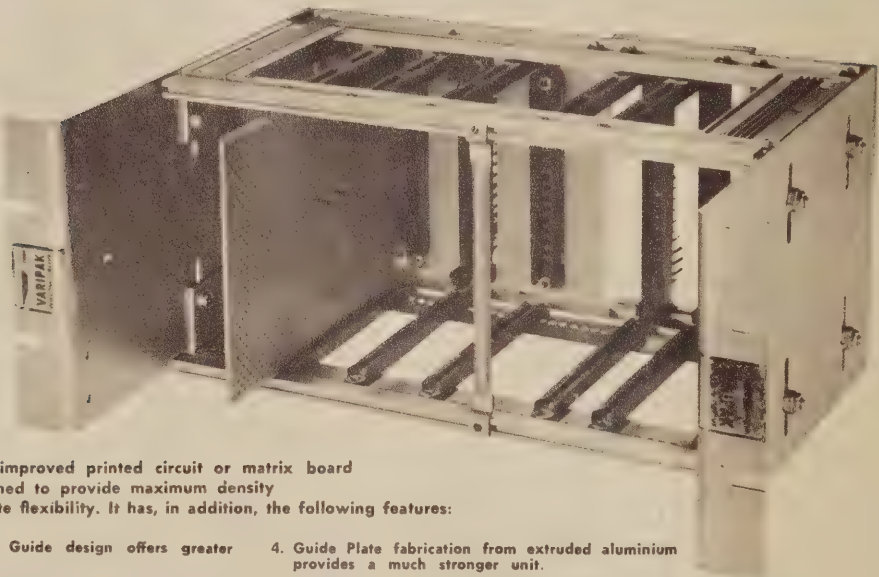
The article gives details of a case history from the files of Human Inventory Inc., of Los Angeles (President Dr Richard R. Stephenson) to show how successful a computer-arranged marriage can be.

No. 2134 is a not overly handsome 29-year-old computer programmer at a west coast data processing centre. He has a Bs. degree in statistics, earns a little less than $12,000 a year and has an abiding interest in his twin vocations: electronics and statistics. In his teens, No. 2134 had "fallen hard for any number

ELCO

# NEW VERSATILITY VARIPAK II

## PRINTED CIRCUIT CARD ENCLOSURE



VARIPAK II is our improved printed circuit or matrix board card enclosure designed to provide maximum density coupled with complete flexibility. It has, in addition, the following features:

1. Simplicity of Card Guide design offers greater strength.
2. Guides can be easily inserted into Guide Plate and also quickly removed from any position without damage to either the Guide or the Guide Plate.
3. Card Guides have sufficient float to allow for any tolerance accumulation between the Card Guide and connectors.
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5. Connector Panel is assembled with machine screws and nuts rather than self-tapping sheet metal screws.
6. Sixteen standard sizes covering a wide range of printed circuit card sizes are available.
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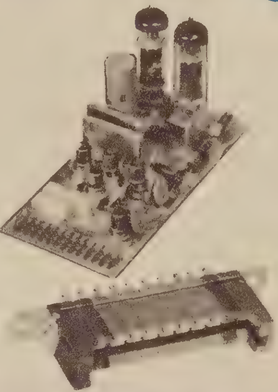
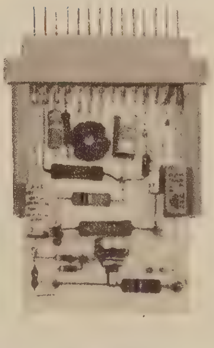
The Elco 5002/4 Series Printed Circuit Connectors shown with a printed circuit board is unique in its design and flexibility. The actual connection is made by a male contact attached to the P.C. board by a simple staking operation. This ensures a degree of reliability which cannot be obtained by the old method of connection. This method relied on the foil of the P.C. board for the actual male contact and unlike the ELCO contact, did not provide the gold surface now considered almost essential by experienced circuit engineers.
The connector itself is made from individual modules and can be readily altered if this becomes necessary at some later date.





An ELCO 5023 Series Printed Circuit Connector with a Vector-Board Type 837BWE epoxy glass matrix board is an ideal combination for prototypes. The strong board will withstand even the most rugged handling and can be drilled or punched for mounting components with no danger of cracking or breaking.
Elco contacts may be quickly staked to the board, if required and by using the special MINI-KLIP terminals for component mounting, the board may be wired in the same actual layout which will be used when a printed or etched circuit module is made. This means that even in the very early prototype stage the circuit can have all the advantages of plug-in facilities.

Technical Data Bulletins 00-5002, 00-5023 and the Vector leaflets may be obtained from any ELCO Distributor

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of girls," he concedes, and during colege and afterwards he dated frequently —but never seriously until the day in May, 1963, when he met No. 576.

Number 576 is a pretty, but not beautiful, 26-year-old legal secretary and college grad. whose father, a physician, still tends his ham rig with he same affection he shows his patients. Number 576 would have listed "marriage" as her main goal in life, but admits, "Even though I've always dated quite a lot, I'd about given up finding the just-right fellow — until I met (she gives his name) No. 2134."

Today, No. 2134 and No. 576 are happily married — one among hundreds, perhaps thousands, of couples brought together by an electronic computer.

Despite "electronic" backgrounds, Bob and Mary, as we'll call them, are sensitive to the "stigma" of their electronic courtship. In the security of his anonymity, Bob declares, "I am 100 per cent convinced — as both a statistician and electronist — that scientific introduction, such as Mary's and mine, is the wave of the future . . . as, for us, it proved to be the wave of the present."

Human Inventory Inc., though a comparative newcomer to psycho-electronic matchmaking (it is now in its fourth year), claims an "inventory" of well over 4,000 clients (all potential mates) and, indisputedly, is among the nation's most studiously scientific of mate-finders.

HI's basic psychological screening is a thorough-going 500-item true-false personal audit: the "Pair Test" (which stands for "Psychological Audit for Inerpersonal Relations"). Devised by Dr Stephenson, who received his Ph.D. rom the University of Minnesota and taught at both Minnesota and the University of Iowa, the "Pair Test" measures applicants on 20 separate "scales" which weigh compatibility factors in marriage.

Six of the "scales" measure basic personality factors—for example, whether a person possesses a low or high degree of "dominant leadership" or, its opposite, "dependent suggestibility." Six others delve deeply into behavioural factors—a person's rating in such matters as "Order and Routine" and "Intellectual Control." Four of the "Pair Test's" scales measure attitudes—among them attitudes toward "family," "money" and "social status."

Some scales seek out "likenesses" which make for compatibility. Others eek to pinpoint critical differences which or true compatibility, are as essential as likenesses. Thus, a high degree of "dominant leadership" in one partner presumably the male) demands, for compatibility, just the opposite in his mate: a high degree of "dependent suggestibility."

Human Inventory's tests (including some designed to spot cheaters: those who might attempt to fake their answers) go far beyond even this complex "interpersonal" appraisal. Applicants are asked (on a separate and carefully calculated form) to rate themselves a "self-descriptive" audit which often —when correlated with their "Pair Test" ratings—is vastly revealing. Applicants also state their preference of partners as to age, height, weight, religion, education, race and other factors. As yet another cross-check, HI asks applicants to supply what psychologists term a "peer rating": a check list on which a friend or relative confidentially checks any of 100 items . . . as descriptive of the applicant (samples: he's a "social climber," "impulsive," "like parties," "spends wisely").

When a computer "pairs" a couple, each receives by mail a "Client Referral" slip listing only a code number and about 12 items of data, including, education, marital status and occupation. Before exchanging names and addresses, clients are encouraged to correspond for some time—usually several months—using only their agency code numbers, with the HI office acting as forwarding agency. Once the name and location of the opposite number is known, a personal meeting usually follows within a few weeks.

Bob and Mary were unusual. Their eventual meeting (and marriage) was the product of HI's initial "electronic sorting." Many mate-seekers correspond with upwards of a dozen "compatibles" before meeting or, in fact, even learning the other's name. Some never meet. Something in the tone of one or the other's letters kills the romance before it has ever begun.

Not surprisingly — in view of the scrupulously scientific approach—Human Inventory's "inventory" is top-heavy with professional people, men as well as women. HI claims that 60 per cent of its male applicants hold college degrees and that 10 per cent of these have advanced degrees (many are doctors, lawyers and Ph.D.'s). Engineers, says Dr Stephenson, comprise about 30 per cent of the male inventory.

"But machines do not replace or eliminate romance," points out Dr Stephenson. "They merely provide a better-risk selection of acquaintances with whom a person can 'fall in love'."

Even though years of preparation have gone into his "Pair Test," Dr Stephenson is quick to acknowledge that as yet he has no long-term validation in terms of marriage success. "Psychological tests of the kind we've devised require years for correlation and validation," he explains. "It takes time—10 years, perhaps even 20 years—before the variables in such complex test scales can be precisely weighed against the others . . ."

Electronically, Human Inventory makes use of the facilities of the famed National Computer Systems centre in Minneapolis, Minn. Here, at one of the nation's largest test scoring labs, the raw test scores from the "Pair Test" are electro-optically scanned by NCS's document reader (5,000 sheets an hour) which puts the information on magnetic tape. The tape feeds a Control Data Corp. 160G computer which, in turn, controls an electronic punch card machine that translates taped data into some ten punch cards. In this basic card form, data can either be programmed through computers (to turn out various statistics aimed at validating test results against marriage results), or returned to HI's Los Angeles office where the cards are often electronically sorted 45 or more times to narrow to "finite compatability" the matching of potential mates.

After weeks of testing and scientific matching, electronics has done as much as it can be expected to do. The rest is up to chemistry—the catalyst of love and marriage.

# METAL LOCATORS—Continued

working at 100 to 1,000 cps. Some have selectable frequencies. Other (external) sources of AF can be used.

An AF locator is at its best on long lines. Up to five miles is quite practical, with excellent accuracy and reliability. Lower frequencies carry further and confuse less, but lose the radiation feature of RF.

The best locator, in case you're going to ask, is determined more by the job at hand than by the locator's price tag, which may be from $100 to $1,000. Anything from a hairy-spaghetti did-it-yourself to a glossy big geophysical set can be counted on to do a good job within the limits of its design.

To clear your head on the matter of locators, try a 15-minute workout using the running motor of your car, a pocket transistor radio and a length of buried stuff such as a water or sewer line under your basement floor or underground wiring to a garage or to a garden light.

Clamp or twist a wire of any size to an exposed part of the pipe or cable for a good electrical connection. Insert the other end of the wire, bared and possibly looped, into a sparkplug lead of your car. Start the car, turn on the radio, which must be tuned off any station, and search for the raucous pulses of the ignition.

You should find them very loud within 3 or 4 feet of the ignition wire and your wire lead. They should also be very apparent along the buried stuff for several feet to either side and for its whole length, or 50 feet of it at least.

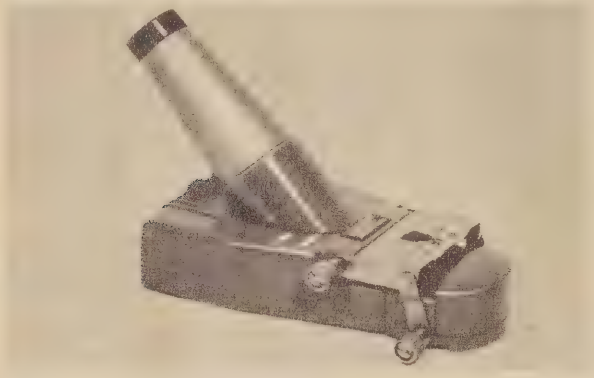
Don't be surprised if the signal is also apparent in other house wiring, water and other facilities. As you play around with the radio you'll learn many things. You'll find that you can't locate the line any better than within a broad band about as wide as the depth of the metal. Your sharpest results will be with the volume turned down to a barely audible level. An earphone is better than the speaker.

A little more study and you'll see that the radio would perform better if the AVC were cut out—AVC tends to dull the sharp edges of signal areas—and if it had a sharply directional pickup, such as a loop. More, the ignition type transmission with both AF and RF components and a hashy trail between could be better for some purposes if it made up its mind one way or another.

In short, this experiment will lead you to a conclusion that a metal locator, like every instrument in your kit, will do work that nothing else can; but its use still depends on that well known button at the top of your spine.

**EDITOR'S NOTE.** We ask readers to note that we cannot enter into technical correspondence on this subject, and we particularly emphasise that we cannot give circuits or constructional details for any of the metal detectors described, since this information was not included in the original article, and we have no suitable data on file. However, we point out that details of a pipe and wiring tracer were given in an article published in the September, 1965, issue. Copies of the article are available through the Reader Inquiry Service.

**MAGNECORD P58H Professional Studio Turntable** (meets Australian Broadcasting Control Board Standards), less than .1% WOW and FLUTTER. Heavy cast base. Hystersis synchronous motor, actually is used in 70% of Australian Broadcasting Stations.



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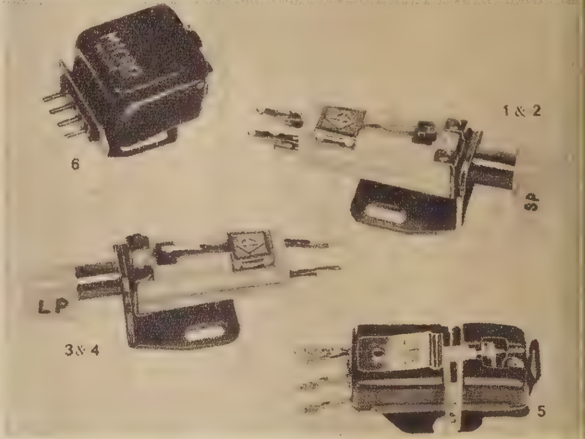

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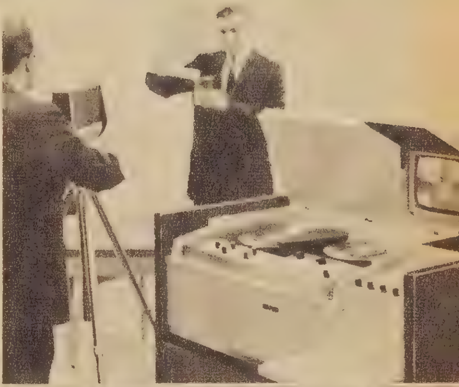
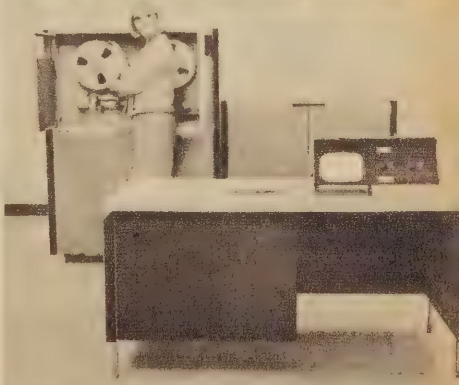
MCX.2

# Ten Years of Videotape Recording

In April, 1956, the world's first practical videotape recorder was unveiled at the National Association of (Radio and TV) Broadcasters' Convention, by the Ampex Corp., of Redwood City, California. At that time Ampex was a small company specialising in the production of professional audio tape recorders. Since then the videotape recorder has found acceptance in many other fields beside TV broadcasting.





Development of the videotape rerder began in the early 1950s, in sponse to the rapid growth of telesion broadcasting. A number of major mpanies in the U.S. and England idertook engineering and development ograms to employ magnetic principles recording pictures and sound.

Ampex, which had enjoyed earlier ccesses in the proprietary developent of the first professional quality idio tape recorder in 1947 and the st high frequency magnetic recorders r recording scientific data soon after, gan engineering work on its successl videotape recorder in 1952.

Although at that time only a small mpany, Ampex had had considerable perience in magnetic recording, and as able to draw on its experience in is field to design the first successful deotape recorder.

In 1958, Ampex brought out the first nversion unit for colour recording and ayback. Last year Ampex enhanced lour tape casting with the VR-2000 gh-band videotape recorder which proices superior colour recordings and ird generation colour tape copies equal quality to previous master tapes.

Taking advantage of the many imovements in recorders, along with imovements in the quality of video tape, oadcasters are finding new ways to it the medium to work for them. iped commercials, syndication of proams by non-network producers, and i-the-spot taping of news and sporting events are becoming more and more common.

While broadcasting has accounted for most videotape recorder and tape sales in the past 10 years, it is being overtaken by sales in the closed circuit television field. In fact, it is estimated that the total video recording market today is about evenly divided between broadcast and closed circuit television.

The use of videotape recorders in closed circuit television has increased greatly in recent years with the introduction of lower cost recorders. From the first high priced recorders used primarily in broadcasting, the cost of videotape recorders dropped to the $10,000 to $15,000 range in 1963. Last year, high quality recorders for about $3,000 were introduced for closed circuit applications.

Closed circuit recorders are proving especially valuable in education. Many universities, colleges, secondary schools and primary schools in the United States and in other countries rely on videotape recorders as an important aid in teaching.

Educational institutions use videotape recorders in such courses as science, language, engineering, music, physical training and many others. Videotape recorders enable schools to record lessons prepared by their best teachers for later playback to large numbers of students. Tapes may be saved and shown repeatedly or erased and used to record another lesson.

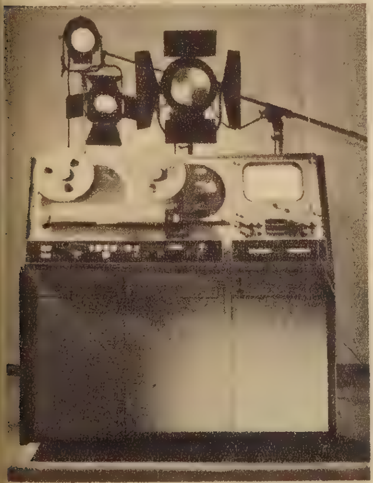
Industry uses videotape recorders to train employees and increase the effectiveness of sales personnel. Hotels offer videotape recording services to guest companies for conducting business and training meetings and to program local information and entertainment to guests.

In medicine, doctors record fluoroscope pictures for repeated analysis without exposing patients to excessive radiation. Psychiatrists record and play back patient interviews. The videotape recorder permits recording and later playback of delicate operations for study of surgical techniques.

Police and firemen have tested videotape recording with positive results for surveillance, recording crime scenes, traffic control and other uses.

In a brief decade videotape recording has matured into a worldwide industry accounting for $100 million in yearly sales. Indications are that it will continue to become an even more dynamic industry in the years ahead. ■

*One of the advanced model videotape recorders currently made by Ampex is this Model VR-2000, suitable for colour and monochrome recordings. Ampex claim it can produce third generation duplicate colour tapes equal in quality to master tapes.*



*TOP TO BOTTOM: The first network broadcast using videotape was on 30/11/56 from CBS TV City, Hollywood.*
*Mobile Ampex "Videotrainer" records science experiment on tape for replay to students throughout school district.*
*Home video recorder can be used to make "instant home movies."*
*Ampex "Videofile" stores documents electronically on videotape, and allows them to be erased, replaced, up-dated and rearranged.*

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Illustrated is the SMG 212 tone arm and the SPU-GT-E cartridge. ORTOFON tone arms are available in 9 models Type "A" cartridges are for general hi fi use . . . type "C" for professional users and the serious music lover. The SPU series has been designed for all high quality stereophonic applications Any cartridge may be used with ORTOFON "G" arms when fitted with the open-front metal "G" shell

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Over 90% of Australian professional users . . . the radio and television stations and recording studios . . . have standardised on ORTOFON moving coil pickups. What are the advantages of the ORTOFON moving coil system? Firstly, the ORTOFON system is inherently more linear, as well as being consistently stable and predictable . . . and **absolutely free from distortion.** Stereo demands higher performance standards and even minute distortion is unacceptable; non-linear distortion makes the best high fidelity system sound second rate. Other magnetic systems such as variable reluctance, moving iron and moving magnet are subject to problems involving non-linear hysteresis and transient distortion. ORTOFON moving coil principles completely eliminate these factors. An open invitation is extended to you to compare the ORTOFON SPU-GT-E moving coil cartridge (illustrated) with any other cartridge regardless of price . . . and listen to the astounding difference!

# FOR GREATER CLARITY AND NATURAL MUSICAL REPRODUCTION OVER THE COMPLETE SOUND SPECTRUM INSIST ON

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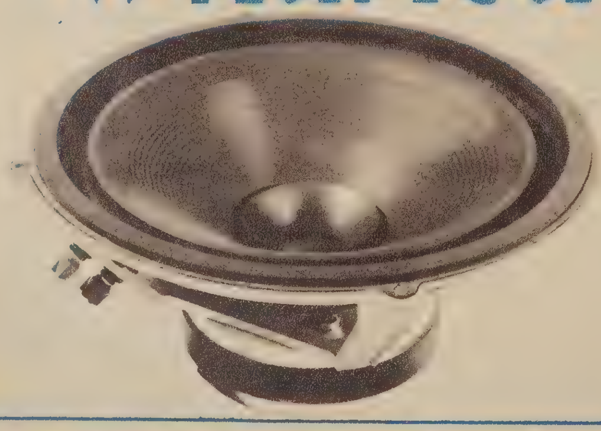

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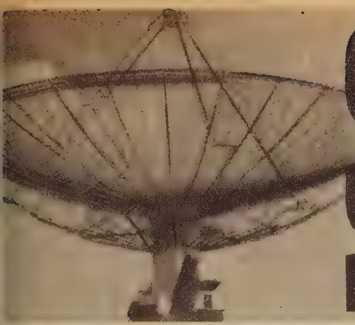


# SCIENTIFIC AND INDUSTRIAL NEWS

## Atom powered heart battery

A heart pacemaker — a device that gives electrical pulses o keep the heartbeat normal — using nuclear power, is now oreseen by the United States Atomic Energy Commission. A New York report said the Commission is initiating a program or development of a self-contained device powered by a radiosotope, which could be inserted in the body by surgery and o be independent of batteries.

The Commission has invited technical proposals. The ninimum operating life would be 10 years, or two or three imes the lifetime of existing pacemakers. It would operate at a power of several hundred millionths of a watt and be fuelled by plutonium 238.

Safety against radiation exposure is one of the objectives. Plutonium 238 has low shielding requirements, because it emits only alpha particles, which are stopped by even a thin sheet of plastic.

The estimated cost of the first phase (engineering design, component development and short-term testing) is $US500,000 to $US750,000. This phase should be completed in less than two years. If this is successful a second phase would proceed to assembly and fabrication and performance tests.

## Radio controlled shopping baskets

To counteract the large number of shopping carts and baskets which disappear from large supermarkets, R. A. MacPlum Industries Inc., 175 Entin Road, Clifton, New Jersey, U.S.A., has devised a shopping container incorporating a warning signal system which operates whenever the container is transported beyond predetermined bounds. The container also has a radio receiver for passing advertising messages to the customer, for announcing the week's "specials" or where to find particular goods. The apparatus is small and does not prevent the container from being telescopically stacked.

## Eliminating the steering wheel

Steering wheel columns which sometimes skewer the driver in a car crash are a major accident hazard. Many American cars now are fitted with collapsible columns, but the Dual Wheels Company, Brooklyn Avenue and Marion Place, Baldwin, New York, does away with the normal steering wheel entirely.

Instead, the car is guided by two small wheels placed edgewise at each side of the driver's seat. The wheels are connected by flexible shafts to the steering gear. Dual Wheels says they can easily be fitted to existing cars.

## New missile deterrent

A weapons system which is said to be the most effective deterrent against nuclear attack developed in the Western world will be made for the U.S. Defence Department under the terms of a contract awarded to the Lockheed company, worth $US26.5m. It is the Poseidon missile, which Lockheed says is a "greatly improved submarine-launched weapons system with increased capability and accuracy, eight times more effective than he old Polaris missile."

## Deflatable tyres for aircraft

Aircraft tyres that deflate in the air but which inflate for each landing have been developed by the B. F. Goodrich Company of 500S. Main Street, Akron, Ohio. The advantage claimed is that they take up less space in the body of the aircraft during flight.

The tyres are now under evaluation by the American Air Force. Goodrich says they take only half to three quarters as much space as conventional landing gear tyres and when deflated (sidewalls fold in under the tread) are little larger than the wheel. Inflation is automatic when the landing gear is lowered.

## Laser welding report

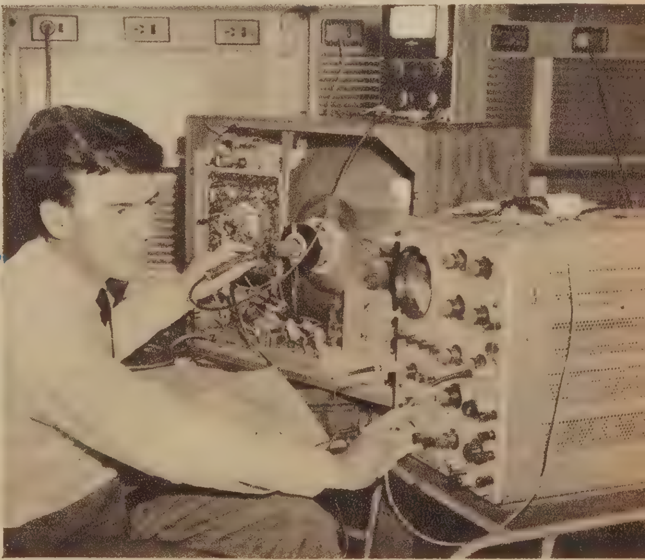
In the rapidly increasing field of micro-miniature electronic packaging design, the ability of the laser to produce precise reproducible fusion welds only one mil in diameter, or even smaller, promises to make it an extremely useful tool, both in the design laboratory and on the production line. Details of this and other suggested applications for lasers are given in a new Laser Welding Research Report available from Union Carbide Corporation, 270 Park Avenue, New York, N.Y., U.S.A.

The report highlights circuit board welding methods which produce excellent fusion welds on all conventional types of claddings without any damage to the substrate. Also described are solder reflow techniques employing the laser as a heat source to join integrated circuits and other devices to boards where melting and fusion of the board cladding is not required. Examples of unique laser welder applications include: the joining of insulated wires to terminal lugs without stripping the insulation; and repair welds on elements inside vacuum tubes. In connection with the latter, a method of bending wires by precisely controlled, localised heating with the laser beam has been developed.

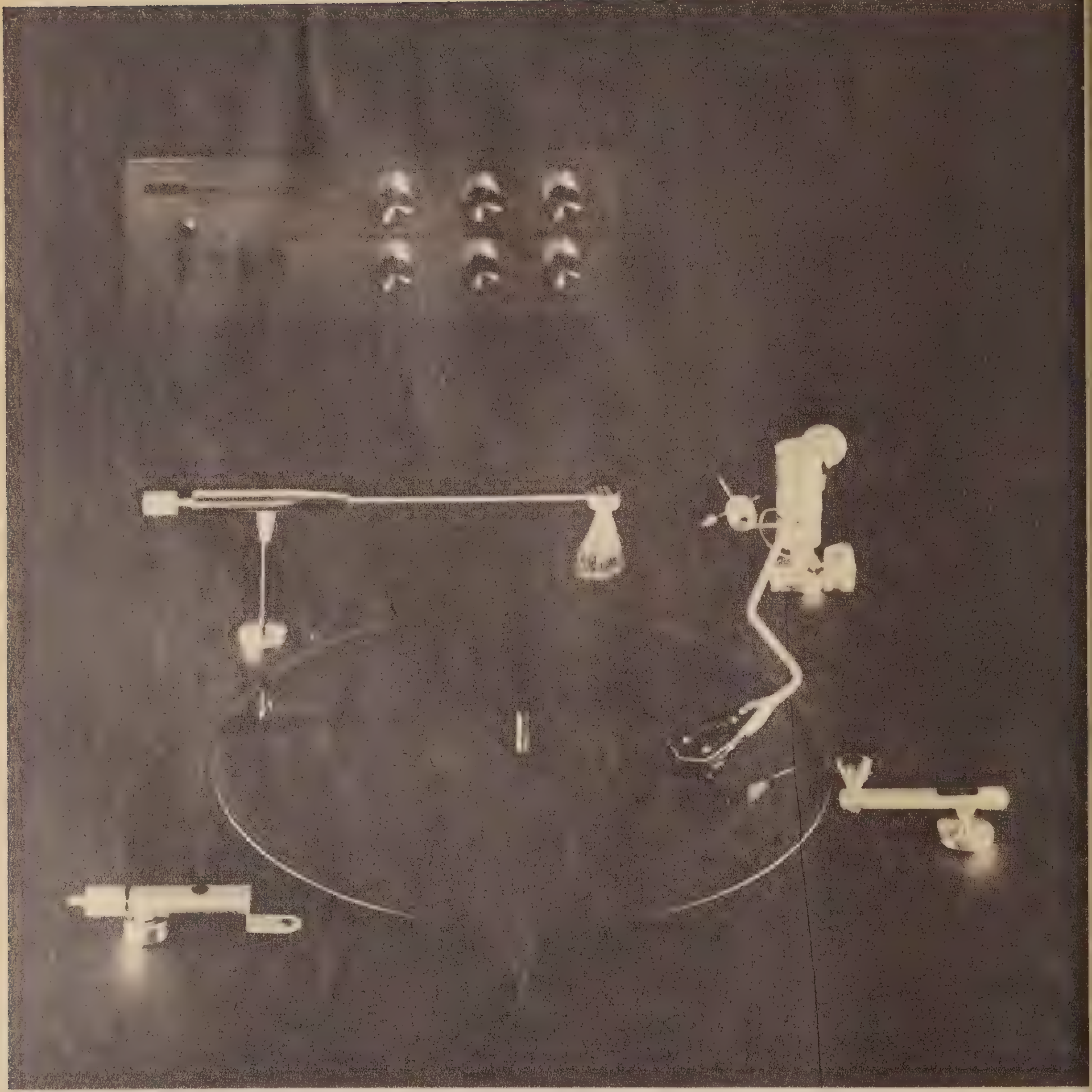
## Proximity switch

Mechanical failure due to wear, fatigue, seizure, corrosion or liquid penetration is eliminated in a proximity switch consisting of a simple coil assembly potted in epoxy resin and housed in a heavy duty metal sheath.

Associated with the coil is a remotely mounted control-section containing a solid-state switching circuit. This is a highly stable system until the coil in the switch head is unbalanced by the presence of metal over the front face. This causes a rapid change in the circuit currents and the solid-state amplifier



*A winner of the New Zealand Craftsman Training Foundation Award, Mr Leo K. Barnes, of Auckland, is now training at the A.W.A. works at Ashfield, and is seen here checking the performance of a TV receiver. Established in 1964 by a group of Auckland Rotary Clubs, the Foundation now includes a large number of N.Z. organisations among its sponsors. The object is to provide opportunities for young craftsmen in vocations requiring systematic training to widen their skills and advance their technical knowledge by working overseas. Winners agree to return to N.Z. for at least two years after two or three years' training abroad. Mr Barnes was one of the first group to be sent overseas by the Foundation.*



**UNIVERSAL FLUID ARM — 10″**
An ultra light weight arm incorporating a precision uni-pivot and using a viscous fluid for lateral support, stability and resonant damping. Pivot friction is not measurable by normal means. Complete with precision lifting and positioning assembly also an anti-skating bias device. All conceivable adjustments are provided for. Integrated leads and phono plugs already fitted. Single hole mounting. Suitable for modern light weight cartridges tracking at 3 grams or less.

**STYLUS BRUSH.**
Manufactured to the same high standards as all other products. Squirrel hair brush.

**UNIVERSAL STANDARD ARM — 10″.**
Similar in most respects to the fluid arm but without anti skating device. The precision uni-pivot is of conventional design. Has same ultra low mass as fluid arm and superbly engineered from finest materials. Suitable for high compliance cartridges tracking at 3 grams or less.

**SWEEP ARM — 10″.**
Uses only finest and softest squirrel hair for sweep brush. These qualities allow for complete removal of foreign material without any damage to the records. Mounting height is adjustable allowing carefully balanced operation.

**STYLUS SCALES.**
Capable of precise measurements to 1/50 of a gram, these scales allow more precis tracking weights to be easily accomplishe This precision instrument operates on finely made uni-pivot with adjustab balance cursor and bubble balance i dicator.

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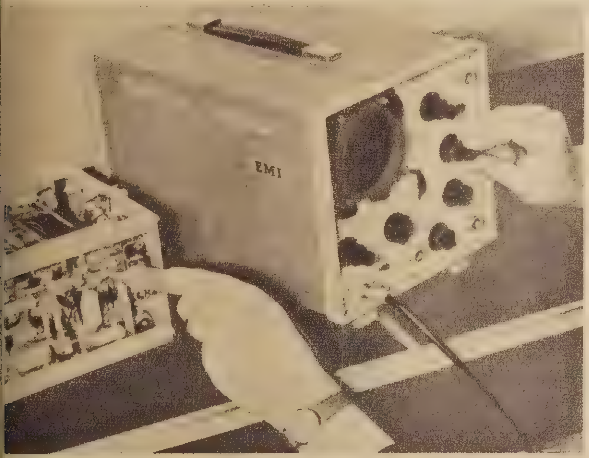
n the control set will immediately switch to a different voltage evel suitable for operating an alarm relay or other control ircuit. Apart from the sensing face, the whole unit may be mounted in solid metal.

In one application, with a specially designed control unit, he switch is suitable for use on machine tools since it is ble to discriminate against ¼in swarf chips while operation is obtained from steel actuators of one inch by one inch and above.

The makers are Mec-Test, of Copse Road, St. Johns, Woking, Surrey, England.

## Landing mats for aircraft

Aluminium honeycomb panels weighing only 4lb per square foot, but strong enough to withstand the landing impact of an aircraft, have been developed by the Kaiser Aluminum and Chemical Corporation of 300 Lakeside Drive, Oakland, California. Kaiser has a 25 million dollar contract for the panels, which are spread on soft ground to make runways for military aircraft. The honeycomb material is sandwiched between two heets of heat-treated aluminium, framed in extruded sections.



*E.M.I. Electronics, of Hayes, England, have developed a high-performance low-cost solid-state measuring oscilloscope which operates from 12V battery or AC mains. Features of the instrument's performance are stable triggering up to 30MC, Y-amplifier bandwith of 15MC and sensitivity of 50mV/cM. Because of its compact size and low weight, and ability to operate without mains supply, it is expected to be particularly suitable for mobile operations on land, sea and in the air.*

## ADF's for Macchi trainer aircaft

A contract worth about $500,000 for the supply of automatic direction finding systems for the R.A.A.F.'s new Macchi trainer aircraft, has been awarded by the Department of Supply to Bendix Tecnico Pty. Ltd., Sydney, the aerospace engineering member of the Pye group of companies in Australia. Minister for Air Mr Peter Howson said the ADF system to be used would have a maximum content of Australian-made parts.

The R.A.A.F. carried out technical and operational evaluaion of all known comparable systems in Britain, U.S.A., Europe and Australia before selecting the Bendix Tecnico system. The Minister said the order had been placed after it had been proved o the satisfaction of the R.A.A.F. that the system compared avourably with any other in proven reliability, prompt delivery, adequate support and modern development.

A statement from Bendix-Tecnico says that these are the irst airborne "black boxes" ever built in Australia for purely military purposes. Conventional ground and air equipment has been produced here, but the critical area of advanced military avionics has not yet been served by Australian manufacturers. The Bendix devices, which are the same as those used in the U.S.A.F.'s biggest transport aircraft, the Starlifter, will be made n a new factory at Rockdale, N.S.W.

## New Radio University course

A course of ten one-hour lectures on "Reliability Engineering" will be broadcast over Radio University VL2UV transmitters in Sydney and Newcastle, commencing in July. The course will deal with the methods of measuring, predicting and improving the reliability of manufactured materials, parts, assemblies and systems, and will be of interest to designers, engineers and production managers in industry. The lecturer, Mr H. S. Blanks, is senior lecturer in the University's School of Electrical Engineering, who has made a special study of quality and reliability engineering.

In Sydney, lectures will be broadcast on Tuesday evenings, with a repeat on Wednesdays, commencing 7 p.m. in each case. In Newcastle, lectures will be on Tuesday evenings only, at 7 p.m. The fee for the course is $6, which includes the cost of printed notes.

Further information and enrolment details can be obtained from Radio University, P.O. Box 1, Kensington, N.S.W. Closing date for enrolment is July 1st.

## Porcelain from slag

Blast furnace slag is being used by Nihon Gaisha K.K., No. 1, 2-chome, Hotta Dori, Mitzuho-ku, Nagoya City, Aichi Prefecture, Japan, to form the basic ingredient of a material strongly resembling porcelain. Mixed with amounts of ceramic minerals, the composition is melted and moulded and the moulded articles heat-treated. As well as "ordinary" porcelain, articles with tougher, more translucent properties, superior to the genuine article, can be produced, it is claimed.

## One seventh of U.K. power now nuclear

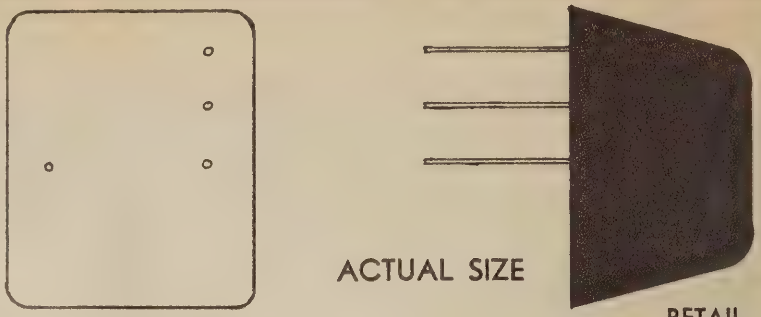
Some 2,000 million kilowatt-hours of power are now being generated by nuclear stations in Britain each month, to provide nearly 14 per cent of the total output of electricity. This is a higher proportion than in any other country.

Nine stations containing 22 gas-cooled graphite moderated reactors are now in operation, with a capacity to send out 3.38 million kilowatts to the grid. All but two of the stations, Calder Hall and Chapelcross, which are owned by the Atomic Energy Authority, are controlled by the statutory electricity generation boards. Two more of the nine, Dungeness A and Sizewell, came on power recently, but the seven operating through last winter all maintained load factors of over 90 per cent and exceeded their design capacity.

Two stations now being built, Oldbury and Wylfa, will complete Britain's first power program before advanced gas-cooled reactors begin to be introduced with the B station now building at Dungeness. The first program will provide a total capacity of 5,000 megawatts and the second, taking in the advanced reactors, 8,000 megawatts.

*With the development of bright radar displays it is no longer necessary for air traffic control centres to be in semi-darkness. The display in this picture is a new Marconi model, Type S3006, which is said to be almost 1,000 times brighter than conventional displays. The picture was taken in normal daylight inside a building, and with flashlight illuminating the screen, yet the radar picture is clearly visible. A video map is incorporated in the display, showing the coastline of S.E. England and airway routes. The Marconi Company says bright displays are a major step towards reducing the tremendous pressure on air traffic controllers, as they eliminate the strain of working in semi-darkness.*

# CORDOVER SOLID STATE MODULES



| NAME | DESCRIPTION | CODE | RETAIL PRICE |
|---|---|---|---|
| ELECTRONIC SIREN MODULE | For pushbutton operation. Provides upward scream then downward wail (when pushbutton is released). | SM-1 | $8.20 |
| BURGLAR ALARM MODULE | For "interlock type switch" operation. Provides continuing upward scream when actuated. | SM-2 | $8.20 |
| MODEL R.R & TOY SIREN MODULE | Similar to "Electronic Siren Module" above, but at appropriate toy volume. | SM-3 | $8.20 |
| FIRE ALARM SIREN MODULE | Built-in adjustable temperature sensor triggers upward screaming siren. | SM-4 | $11.70 |
| PUBLIC ADDRESS AMPLIFIER MODULE | Input-Carbon microphone: Output—Will drive up to a 15in speaker at volume to carry several hundred yards. | PAA-2 | $4.70 |
| PUBLIC ADDRESS AMPLIFIER MODULE | Input—High impedance microphone. Output — Will drive any size P.M. speaker to auditorium volume. | PA-9 | $8.20 |
| C.B. MICROPHONE PREAMP MODULE | Increases your HI-Z microphone output to optimum for more dependable transmission of portable transreceivers. | MP-7 | $8.20 |
| INTERCOM MODULE | To complete intercom—needs only two speakers, battery and switch. | IC-9 | $8.20 |
| GUITAR AMPLIFIER MODULE | Simply connect a contact microphone, a speaker and a battery for concert quality and auditorium volume. | GA-9 | $8.20 |
| TELEPHONE AMPLIFIER MODULE | Connect telephone pick-up coil, speaker and battery — permits group listening to both sides of a conversation. | TA-9 | $8.20 |
| BABY NURSE MODULE | Safe 6 volt battery operation. Will report baby's moving in his crib and even amplify normal breathing. | BN-9 | $8.20 |
| DUAL FLASHER MODULE | Alternately flashes two No. 47 pilot lights at rate of about 100 times per minute. | BB-8 | $4.70 |
| TRANSISTORISED METRONOME MODULE | Requires addition of 6V Battery, PM speaker and 2 meg. potentiometer. Accurate beat 40-208 per minute. | MN-4 | $4.70 |
| PHONOGRAPH AMPLIFIER MODULE | Input—High impedance cartridge. Output — Will drive 8 ohm P.M. speaker to better than average volume. | PH-7 | $9.00 |

**PRICES: The above prices include Sales Tax and are F.O.R. Sydney.**

(Slightly higher interstate)

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PERTH AGENTS:
C. F. LIDDELOW & CO.,
252 WILLIAM ST.,
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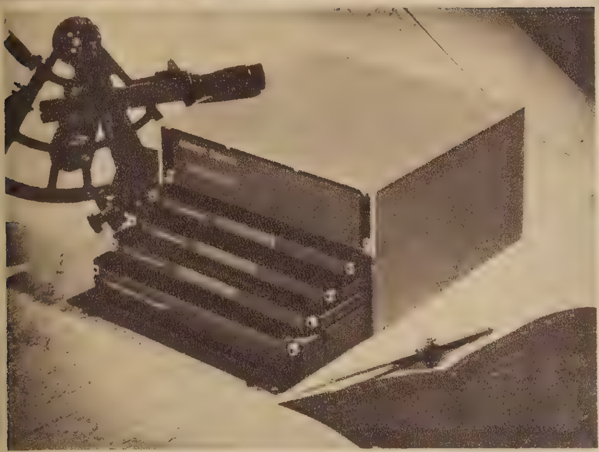
TASMANIA AGENTS:
K. W. McCULLOCH P./L.,
P.O. BOX 606G
LAUNCESTON (2-5322)



*This small package, with a capacity of only 0.3 cu. ft., is a complete computer, which the makers, Litton Industries, claim is the smallest and lightest to offer militarised real time data processing with multiple program and multiple computer capability. It contains 4,096 32-bit words of memory, but this is expandable to 32,000 words and with the addition of memory extension to 131,072 32-bit words. The compact size has been made possible by the use of monolithic silicon integrated and hybrid circuits and miniaturised power supplies.*

## Electronics conference in N.Z.

The New Zealand Electronics Institute (Inc.) and the Intitution of Electronics and Radio Engineers (N.Z. Section) is planning to hold the country's first national electronics conference in August this year. Entitled "Electronics in Action," the conference is designed to appeal to people using electronics in a wide range of activities, and the following sections have been planned: Data Handling, Modern Communications, Research Electronics, Industrial Electronics, Medical and Biological Electronics, Electronics in Aviation, Nucleonics and Electronics in Education.

Anybody wishing to attend the conference can obtain an enrolment and accommodation booking form from Mr R. H. E. Beckett, P.O. Box 3325, Auckland, C. 1.

## Coating diamonds with metal

Diamond particles coated with metal are said to make a grinding wheel which will remove twice as much carbide as a conventional diamond grinder.

The Norton Company, of 1, New Bond Street, Worcester, Massachusetts, developed the system for coating the diamonds, which are then bonded with a resin. The metal "armour" is said to keep the diamonds from being pulled out of the wheel. Such a wheel, it is stated, will remove 316 cubic inches of carbide under conditions in which a standard wheel removes only 135 cubic inches.

## Metal shaping process

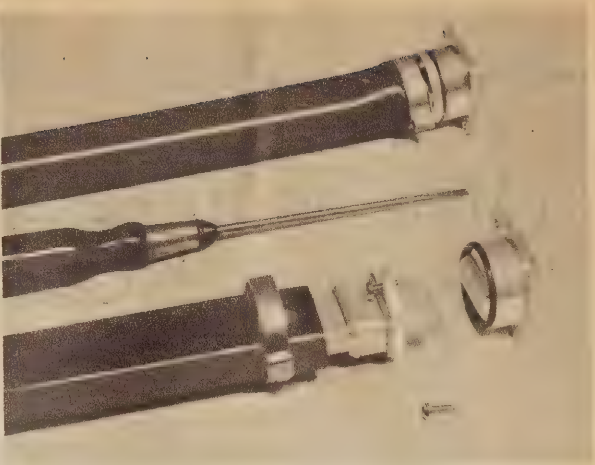
A way of deforming metals by using an electric current to heat them in the areas to be bent and then using an electromagnetic force to carry out the bending and stretching is announced by Deusche Edelstahlwerke A.G. of 16, Oberschlesienstr., Krefeld, and Allgemeine Elektricitats, of 150, Hohenzollerndamm, Berlin-Grunewald, Germany.

The companies have succeeded in producing a whole range of metal components in shaped steel dies. Rings, angles, rounds and rectangular shaped pieces in steel, aluminium, copper and other metals are easily produced and are suitable for almost any metal-component-using industry, it is claimed.

## Meter will warn Concord pilots

A meter which warns pilots of supersonic aircraft, such as he Concord, that they are flying at heights which bring them within dangerous radiation belts has been developed by the British Atomic Energy Authority.

Supersonic aircraft will fly at heights up to 65,000 feet, t which altitude radiation levels due to cosmic rays are higher han those normally met by civil aircraft, which usually fly elow 40,000 feet. If the level of radiation approaches the danger level the meter will give a warning signal and the pilot can educe height in order to provide a layer of atmosphere above he aircraft sufficiently thick to absorb the radiation.



*Also from Litton Industries comes news of this flexible waveguide, known as "Airflex," which can be cut to any length and flanges installed or replaced in the field. The makers claim that the new waveguide is not only less expensive but also better than standard soldered or brazed waveguide assemblies. In use, the brass tubing material is simply cut to length, an extruded Neoprene rubber jacketing is slipped on, and brass flanges are attached with a newly developed clamp.*

## Surface treatment for steel sheets

A pretreating process for steel sheets before they are finally coated with tin, plastic, paint or other coating has been developed by Yawata Iron and Steel Company, of No. 1, 1-chome, Marunouchi, Chiyoda-ku, Tokyo. Unlike anti-rusting oils and other pretreatment materials the coating applied does not have to be removed before the final finishing operation.

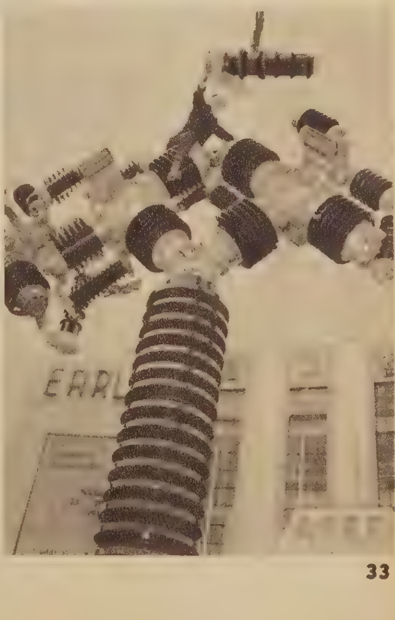
The pretreatment consists of plating the surface of the hot-rolled sheets with nickel, copper or aluminium. Cold rolling of the sheets follows and annealing is then carried out. Sheets can then be safely stored or further processed and then finally coated without further surface treatment.

## Fog off motorways

Efforts are under way by the New Jersey State Highway Department, Trenton, New Jersey, to sweep fog out of the air. The "fog broom" is a network of fine nylon filaments wrapped around a revolving frame. The filaments pick moisture particles out of the air thereby lowering its humidity and raising the temperature so that fog disappears in the tunnel swept by the "broom."

The highway department plans to mount the brooms, already tested in the laboratory, on lorries and drive them through fog patches on major motorways. The hope is that this will prevent strings of accidents sometimes caused by fog patches.

*This giant circuit breaker, the first in Britain, rated at 400,000V, weighs 19 tons and stands 23ft high. It is seen here erected in the forecourt at London's Earl's Court exhibition centre, where it was exhibited recently in the Electrical Engineers' Exhibition by the makers, English Electric Company.*



# MULLARD THYRISTORS UP TO 800V WITH A CHOICE OF CONTROLLED AVALANCHE

The existing ranges of Mullard thyristors, with the exception of the 4.7A series, have now been extended by the introduction of 800V types at four different current ratings. The 50A and 70A versions are available with flat base (flange) mounting as an alternative, thus simplifying mounting onto heatsinks by obviating the need for accurately drilled and tapped holes. The 50A and 70A versions in all ranges now have a second cathode lead for gating purposes to avoid interference in firing circuits. In addition, a new series of controlled avalanche, stud mounted types has been released. These have high pulse absorption characteristics and are also available in four current ratings, with 500V, 600V and 700V types, as well as the 800V versions.

Type numbers for the new thyristors in stud-mounted, flange-mounted and controlled avalanche versions are shown in the Table below. Four new stud-mounted types extend the present range of 12A, 16A, 50A and 70A thyristors to 800V (PIV max).

Intended for immediate use by equipment manufacturers in applications such as DC motor control, furnace control, lighting control, the excitation of alternators and the static switching of power, these Mullard thyristors are now in large-scale production.

## THE MULLARD RANGE OF 800V* THYRISTORS

| Description | Maximum mean forward current | | | |
|---|---|---|---|---|
| | 12A | 16A | 50A | 70A |
| Stud-mounted | BTY87-800R | BTY91-800R | BTY95-800R | BTY99-800R |
| Flange-mounted | | | BTX39-800R | BTX40-800R |
| Controlled-avalanche | BTX35-800R | BTX36-800R | BTX37-800R | BTX38-800R |

* Maximum crest working reverse voltage (PIV max.)

The economics of such applications as thyristor DC motor control are becoming steadily more attractive and if you require more detailed information on the Mullard range of thyristors, our Technical Service Departments are available for advice. There is a Mullard Representative in each State and our products are available from leading Distributors throughout the Commonwealth.

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- 33 Bowen Street, BRISBANE; Qld. — Phone 2 3201
- 266-270 Sturt Street, ADELAIDE, S.A. — Phone 51 6341
- 579 Murray Street, PERTH, W.A. — Phone 21 2561

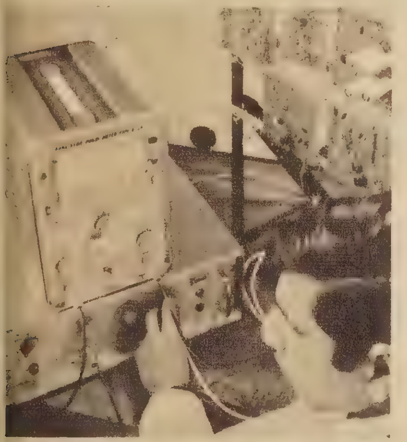
M 1

## Aluminium paste

An aluminium paste which is dispersible in water, paints, varnishes and cellular concrete is reported by l'Aluminium Francais, 23, Rue Balzac, Paris, 8e. The paste is made by mixing aluminium powder, an organic compound and white spirit. The ingredients are mixed in such a way as to produce "flakes" of aluminium which, the company states, gives greatly improved covering power as compared with granulated aluminium.

## Frictionless bearing

Permanent magnets used in frictionless bearings for high speed and light loads use the repulsion of like magnetic poles in the stationary housing and the rotating shaft member to provide concentric support and no metallic contact between the two. A feature of a design developed in United States space work is the bevel given to the pole elements to provide a large surface area for the like poles, as well as better axial support for the shaft than cylindrical designs. Eccentric rotation is prevented automatically by the increased repulsive force present when the air gap between shaft and housing is reduced.



*Illustrated is a transistorised phase meter, Type 632, recently introduced in U.K. by Dawe Instruments Ltd. The instrument measures phase shift and gain, and allows comparisons to be made between symmetrical input signals over the frequency range 50cps to 100KC. Accurate balancing of the input levels is not necessary, and both reference and signals channels have fully compensated attenuators.*

## 60KW power pack

A 60KW power pack which has a long term stability better than one part in 10,000 and a speed response of 5 to 10 microseconds is undergoing tests by the manufacturers, Brentford Electric Ltd., of Crawley, Sussex, U.K. This high degree of stability is vital for the control of beam handling magnets used in nuclear particle research.

## Enamels for aluminium

A range of vitreous enamels for cladding aluminium has been developed by Blythe Colour Works, Cresswell, Stoke on Trent, England. The enamels are suitable for use in any application which demands coated aluminium surfaces. The company states that vitreous enamelled aluminium can be sheared, punched, sawn or drilled without edge chipping or flaking of the enamel. In addition, some improvement in the mechanical properties of the metal is obtained. The enamels are stated to have excellent thermal stability.

*In U.S.A., Lockheed California Co. has perfected a safe, plastic detonator which will not explode even if hit with a hammer and cannot be set off by HF radio waves and other high energy radiation normally dangerous to blasting operations. The device is insensitive to temperature extremes from plus 500 to minus 100 degrees F. In this photo, the inventor, Mr Glen Rardin, shows the result on a lead block of his new detonator, one of which he is holding in his left hand.*

## Stronger seams for plastic

A method of joining together cross-laminated plastic film so that it can be used for heavy-duty bags and other packing purposes has been patented by Ole-Bendt Rasmussen, No. 14, Gyvelbakken, Birkerod, Denmark. The two films to be joined are laid together and holes punched in them along the seam lines. Two strips of molten plastic material are then extruded on to each side of the film, over the holes, so that they flow through the holes and fuse together.

## Recharged batteries

Torch batteries with their own recharging apparatus built into them are now available in the U.S.A. from En-Power Company, Box 1526, San Mateo, California. They are no larger than the corresponding ordinary primary cell for torch use, but have a resistance unit and rectifier encapsulated at one end. Thus, when exhausted they can be plugged into a power point, with the aid of a suitable adapter, and recharged, without the use of a separate charger.

## Waterproof emulsion paint

One hundred per cent waterproof is the claim made for Velpruf exterior emulsion paint now being introduced by George Lillington and Co., of Willow Lane, Mitcham, Surrey. Its covering capacity is 35-45 square yards per gallon for two coats, and it can be used on all types of masonry surfaces and on asbestos cement. One suggested use is painting the sides and bottom of a swimming pool.

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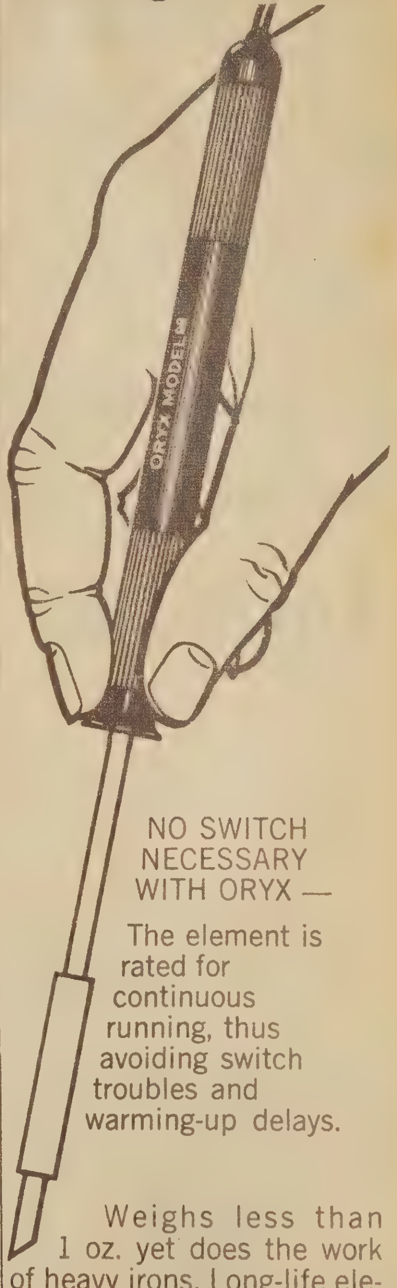

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The element is rated for continuous running, thus avoiding switch troubles and warming-up delays.

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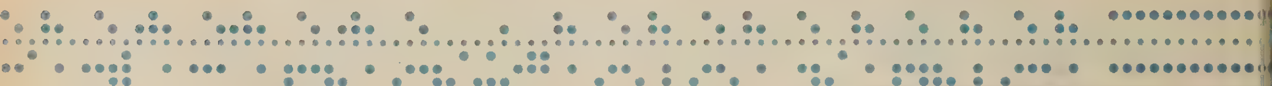
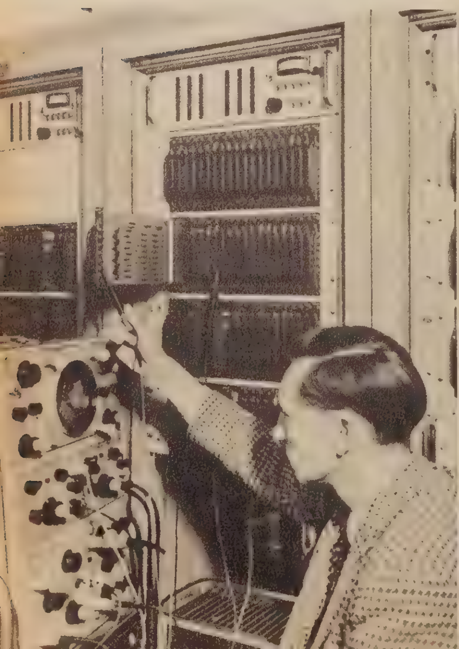
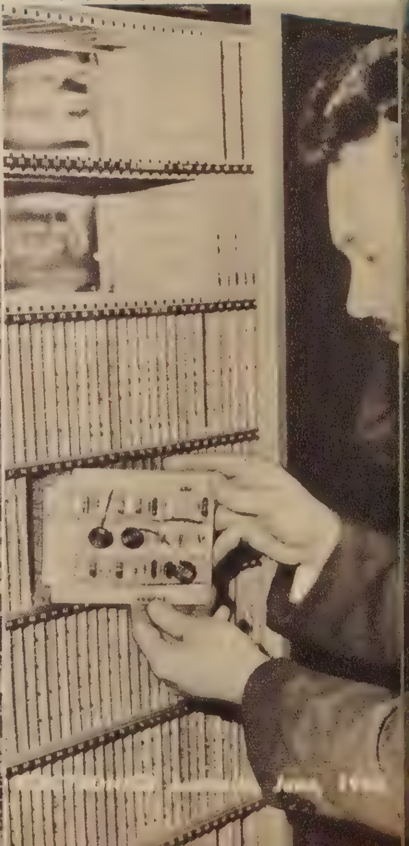
# An introduction to Logic and Counting circuits

*Information stored on punched paper tape.*



Commencing opposite is the first of a short series of articles intended to introduce the reader to the basic concepts, theory and operation of logic and counting circuitry — circuitry which plays an important role in modern digital computers and instruments. The articles will include details of practical circuits which demonstrate the principles involved.





## Logic and counting circuits — 1

# CIRCUIT LOGIC — Why and How

Historical review — why logical concepts are used — the elementary operations AND, OR and NOT — symbols — truth values and truth tables — duality — deMorgan's theorem and other laws.

by Jamieson Rowe

Almost since the dawn of their art, mathematicians have dreamed of having machines which would be able to free them from the drudgery of tedious repetitive calculations. Although this dream is only being realised fully in the twentieth century, modern computing machines are by no means without precedent.

Probably the first to invent a computing machine was the sixteenth century Scottish mathematician John Napier (1550-1617), better known for his invention of logarithms; his so-called "Napier's Bones" was a crude multiplication machine. Napier also was very likely the first "modern" mathematician to conceive the abstract importance of the binary scale—which we will see later to play an important part in the operation of modern computers and instruments.

At the age of eighteen the brilliant French mathematician Blaise Pascal (1623-1662) invented what was probably the first adding machine or "desk calculator" to assist him in the job of keeping his father's accounts.

In turn, Pascal's machine was improved upon by the great German philosopher-mathematician Gottfried Wilhelm von Leibnitz (1646-1716), who invented a machine which could perform counting, addition, subtraction, multiplication and division. Leibnitz realised quite well the advantages of the binary system over the decimal system for "machine" arithmetic.

Although these early calculating machines were important stages in the development of modern computers and instruments, in themselves they did little more than simply point the way in which further developments might take place. For the really big developments could not take place until important discoveries had been made, not only in technology and engineering, but in a subject apparently unconnected with the problem: logic.

Until about the middle of last century logic had remained somewhat aloof from mathematics as a traditional part of the "higher" discipline of philosophy. First presented in an organised fashion by the great Greek philosopher Aristotle (384-322 B.C.), it remained essentially unchanged through ancient and medieval times as an "ivory tower" pursuit of philosophers and as a justification for theological doctrines.

However, the estrangement of logic from mathematics began to dissolve early last century with the publication of the works of two important logicians in 1847. In his book, "An Investigation of The Laws of Thought," George Boole (1815-1854) laid the foundations for a complete symbolism of logic; Augustus deMorgan (1806-1872) provided extensive evidence that logical validity was not confined to the traditional modes of inference.

The work of Boole and deMorgan was developed further by such logicians and mathematicians as William S. Jevons, Charles Peirce, John Venn and C. L. Dodgson ("Lewis Carroll"). Finally, using and extending arguments put forward by the German philosopher Gottlob Frege, the Cambridge logicians Bertrand Russell (b. 1872) and Alfred North Whitehead (1861-1947) published their monumental "Principia Mathematica" in 1910-13. In this work they showed that logic is, in fact, the basis upon which mathematics rests.

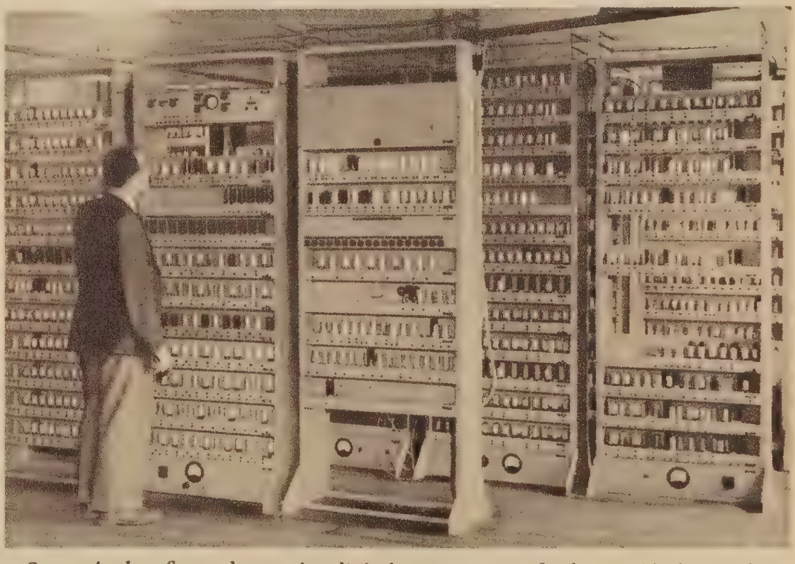
Along with these developments in logic and mathematics the nineteenth century brought advances in technology. The Englishman, Charles Babbage (1792-1871), invented the first really modern calculating machine in 1835. Called an "analytical difference engine," it worked in decimals and could make continual logical decisions throughout a predetermined sequence of operations. It could add 29-digit numbers and if necessary, carry over all 29 digits simultaneously!

Babbage's machine was entirely mechanical since, in his day, electrical engineering was still in its infancy. It was not until the 1930s that the first electrical logic machine was reported to have been built by Benjamin Burack of Roosevelt College in Chicago.

The final step which was to make possible the development of the modern digital computer was made in 1937 by Claude E. Shannon, in his Master-of-Science thesis submitted at the Massachusetts Institute of Technology. In his thesis Shannon showed that Boole's symbolic logic could be used, not only as a means of designing extremely efficient circuits capable of carrying out mathematical operations, but also in the organisation or "programming" of the operations to be carried out by the circuits.

**It had occurred to many that electrical circuits could be used to carry out mathematical operations; however, it had remained for Shannon to show that the concepts of symbolic logic provided the most efficient way of designing such circuits. From this final bringing-together of mathematics, logic and electrical engineering, modern digital technology was born.**

In the late 1940s, the "Mark 1" electro-mechanical digital computer was produced at Harvard University. Soon



*One of the first electronic digital computers, built in 1949 at the Mathematical Laboratory of Cambridge University. It was known as "EDSAC" (Electronic Delay Storage Automatic Calculator) and used some 3,000 thermionic valves. By modern standards it was very slow in operation.*

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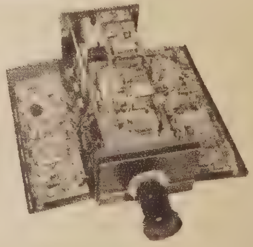

*V322A Camera with top removed and sides opened, illustrating ease of access*

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after, laboratories in both England and America produced fully electronic computers. In the 1950s commercial production began, and since then there has been a veritable avalanche of machines that are bigger, faster, more versatile or more specialised than their predecessors.

It is hoped that the foregoing brief historical review will help the reader in understanding the factors which contributed to the final appearance of digital computers and associated instruments. It should also show why the concepts of symbolic logic (or "Boolean Algebra" as it is often called) have become a part of the knowledge required for a full understanding of the operation of these machines.

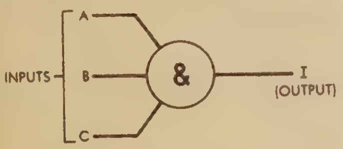
In view of the important part played by symbolic logic in the operation of digital circuitry we may, with profit, commence the study of the operation of these circuits with a discussion of elementary logic circuits.

There are three elementary logical operations from which virtually all logical circuitry is derived; these are designated the AND, OR and NOT operations. Other names for the AND operation are "logical product" and "conjunction"; the OR operation can be regarded as a "logical sum" or "disjunction"; the NOT operation is also known as "logical negation," "complementation" or "inversion."

Consider the elementary circuit of figure 1. Fairly obviously, current "I" will flow through the lamp bulb only if **all three** of the switches are closed. Thus we can say that I, symbolising the condition "the lamp is alight," is logically an equivalent to (A.B.C), where the letters "A," "B" and "C" symbolise the conditions "switch A is closed," "switch B is closed" and "switch C is closed" respectively; the dots (which can alternatively be shown as a product sign ×) symbolise logical conjunction or AND. We can represent this equivalence by the equation

$$A.B.C = I \qquad \ldots (1)$$

Any circuit or device which performs this function of logical conjunction by delivering an output only when two or more input quantities occur simultaneously is said to perform the AND operation. This is symbolised in logical diagrams as:



It is customary to regard the input and output quantities of such a logical operation as **value statements** which may be either true or false, and to symbolise truth and falsity by "1" and "0" respectively.

Thus with regard to the simple circuit of figure 1 the input quantities A, B and C would actually be regarded NOT as switches having the possible properties "open" or "closed," but as a set of statements whose truth or falsity is simply represented by EITHER of these switch properties. (As will be shown later, it is equally feasible to represent "truth" by either "openness" or "closedness" of a switch, positivity or negativity of a circuit potential, and so on).

Making the input and output quantities of a circuit **statements** gives the circuit general applicability to a whole universe of situations which are logically similar; if this were not done the behaviour of the circuit could only yield information about its own specific situation. However, because we can use **any** statements as the input and output quantities, we can even use statements about the circuit itself, for the purposes of illustration.

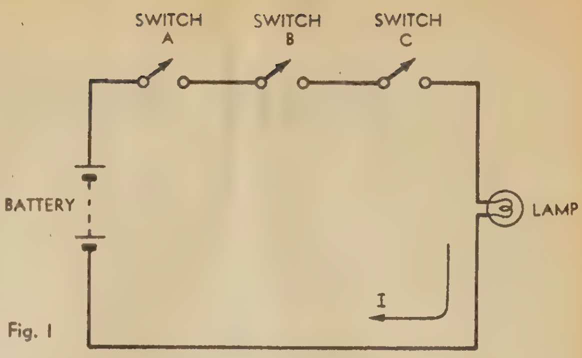


Fig. 1

Thus we can use as inputs the three statements "switch A is closed," "switch B is closed" and "switch C is closed," making these three situations those represented by the symbols "A," "B" and "C." With the circuit as drawn, these statements are obviously false; so we can write "A=0," "B=0" and "C=0." If we closed switch A we would make statement A true ("A=1"), and so on.

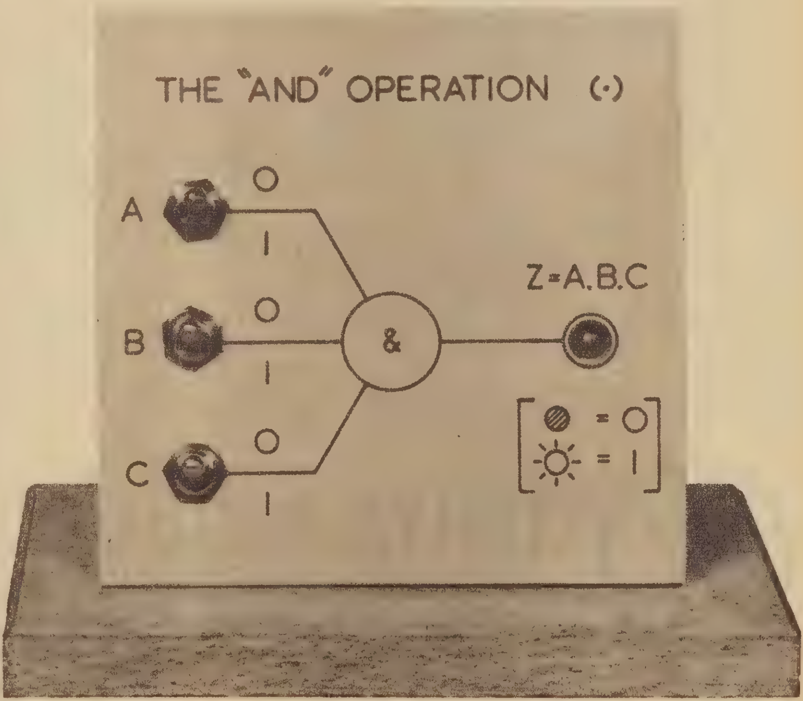
If, as above, the input quantities are taken to be statements about the input switches, the output "A.B.C" becomes the complex statement "switches A, B and C are all closed"; and as the circuit is drawn this is obviously false ("A.B.C =0"). If all three switches are closed to make all three inputs true, this will also make the output true ("A.B.C=1"), and so the particular statement represented by the output will be shown true.

It should perhaps be noted that in logic the values "truth" and "falsity" are solely factual descriptions of states-of-affairs. Note also that although the input and output statements in the above illustration were statements about the circuit itself, there would be no point in practice in having the circuit demonstrate truths about itself!

Making the input to a logic circuit statements allows the AND operation to be defined in terms of all the possible combinations of truth or falsity of the input quantities and the corresponding values for the output quantity. The various combinations may be shown conveniently by means of a so-called "truth table":

| INPUTS | | | OUTPUT |
|---|---|---|---|
| A | B | C | A.B.C = I |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

As the truth table reveals, the output of the AND operation (i.e., "the bulb is alight") is only true when all of its



*Front view of a small unit which may be used to demonstrate the logical product or "AND" operation. It is wired up to the simple circuit shown in Figure 1 at the top of the page.*

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nputs are true (i.e., "switch A is closd," "switch B is closed" **and** "switch C s closed"). For all other combinations he output is false.

It should perhaps be mentioned at this oint that the AND operation is not estricted to three inputs but may involve any number greater than one. Three are shown in figure 1 purely for onvenience of illustration.

Now consider the simple circuit of igure 2. Here we again have three switches connecting a battery to a lamp bulb, but they are now in parallel. Intead of the previous case where all hree were required to be closed before he bulb would light, we now have a ase where any switch alone can allow he current "I" to flow. This circuit performs the logical OR operation, and its operation can be represented by the quation

$$A+B+C=I \qquad . \ . \ . \ (2)$$

where the symbols "A," "B," "C" and I" have the same significance as before nd the "+" signs represent logical disjunction or OR.

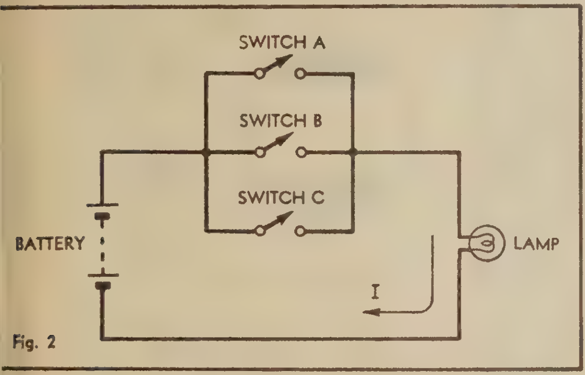
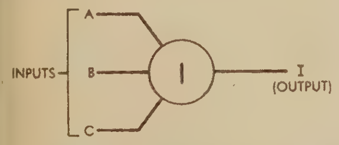


Fig. 2

A circuit or device which performs logical disjunction by delivering an output whenever one or more input quantities are present (true) is said to perform the OR operation. (NOTE the one or more" in this definition; it is ossible to have a circuit which prouces an output when one and ONLY ONE input is present. Such "exclusive OR" circuits are in fact used, but need not concern us at present.) In logical iagrams the OR operation is shown by he symbol:



As before the OR operation may be efined in terms of all the possible comnations of truth or falsity of the inut quantities and the corresponding alues for the output quantity, shown y a truth table:

| INPUTS | | | OUTPUT |
|---|---|---|---|
| A | B | C | A+B+C=I |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

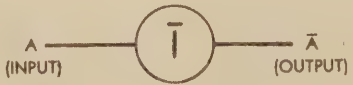
The truth table shows that the output of the OR operation is true for all the combinations where at least one input is true. Thus the output is false only for the single combination where all three inputs are false.

Again, the OR operation is not restricted to the three input statements shown, but may involve any number greater than one.

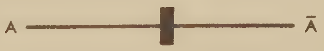
The NOT operation involves substitution of the negation or logical opposite (complement) of quantity for that quantity. The complement of the statement "switch A is closed" is its logical contradiction "NOT (switch A is closed)"; or in familiar language the statement "switch A is open." The complement of a statement is simply a statement which is always true when the original quantity is false, and vice-versa; using a bar above a letter to indicate its complement, the NOT operation can thus be defined by the truth table:

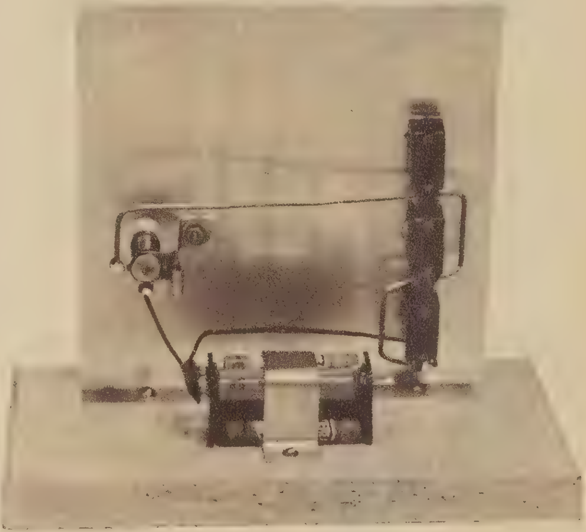
| INPUT A | OUTFUT $\bar{A}$ |
|---|---|
| 0 | 1 |
| 1 | 0 |

i.e., when a statement is true its complement is false, and if the statement is false then its complement is true. In logical diagrams the NOT operation is shown by the symbols:



OR





*A rear view of the "AND" gate shown on the preceding page.*

Having defined the three basic logical operations we are now in a position to examine some interesting properties which they possess. Firstly, consider again the circuit of figure 1.

Previously we have considered the output quantity in this circuit to be the condition where current was flowing and the lamp is alight, i.e., "I". But what happens if we consider instead that the output is the opposite condition, where the lamp is **not** alight? Will the circuit still perform the AND operation?

Fairly obviously, it will not. The lamp will be off if **any one (or more)** of the switches are open—i.e., "the lamp is off" is true when "switch A is closed" is false, or "switch B is closed" is false, or "switch C is closed" is false. Or if you like, the output of the circuit is now true when one or more of the **complements** of our original inputs are true. Our circuit is now performing the OR operation!

In a similar fashion the circuit of figure 2 may be seen to perform the AND operation if we again consider its output to be "the lamp is off" and its inputs to be "switch A is open," etc.

Thus it may be seen that the AND and OR operations are in fact the opposite sides of the same coin; the complement of an AND operation on a given set of quantities is in fact logically equivalent to an OR operation on their complements. This is expressed by the so-called "laws of duality," also called "deMorgan's theorem" after Boole's contemporary:

$$\overline{(A+B)}=\bar{A}\ .\ \bar{B} \qquad . \ . \ . \ (3)$$

$$\overline{(A\ .\ B)}=\bar{A}+\bar{B} \qquad . \ . \ . \ (4)$$

Expressed in words these state that the complement of a logical sum (expressed as "NOT (A or B)") is equivalent to the logical product of their complements ("notA and notB"), and that the complement of a logical product ("NOT(A and B)") is equivalent to the logical sum of their complements ("notA or notB"). Truth tables may be used to show that these laws are quite true in all cases. The first law may be represented by the table:

| ORIGINAL STATEMENTS | | COMPLEMENTS | | SYNTHESISED STATEMENTS | | |
|---|---|---|---|---|---|---|
| A | B | $\bar{A}$ | $\bar{B}$ | A+B | $\overline{A+B}$ | $\bar{A}.\bar{B}$ |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 |

In this table the first two columns represent the elementary statements, with the four possible combinations of truth and falsity of these corresponding to the four horizontal rows. The third and fourth columns show the complements of the elementary statements. In the fifth column is the statement "A or

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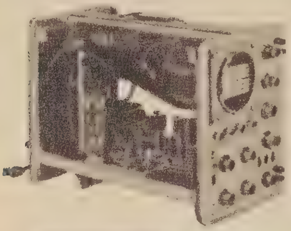

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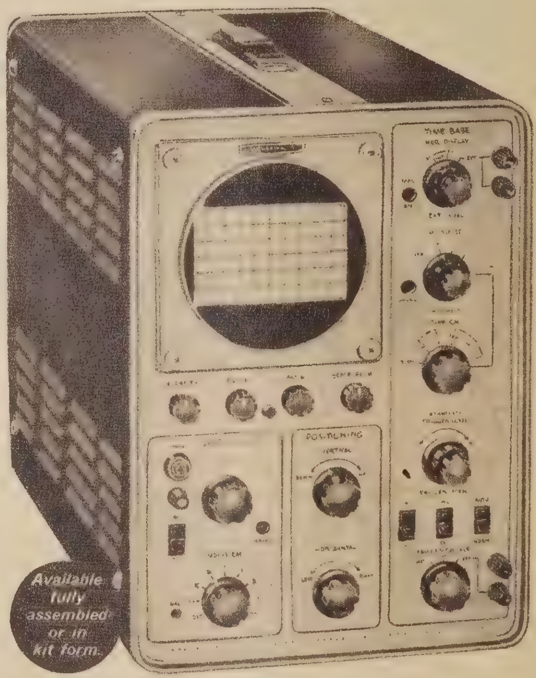

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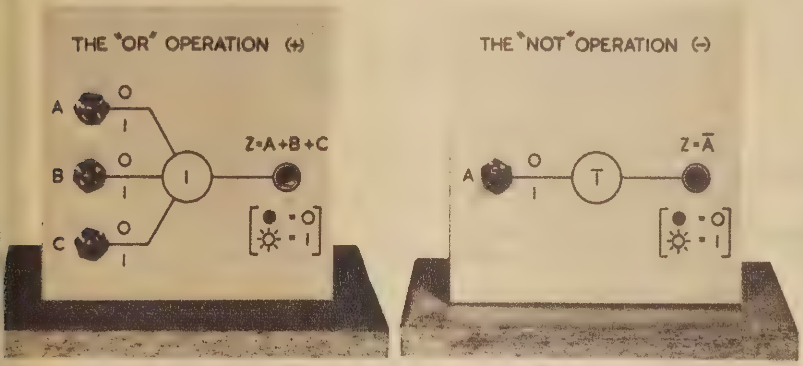
B", followed in the sixth column by its complement "NOT (A or B)". The final column shows the values of the statement "notA and notB" and, as these are identical with the values in the sixth column the two statements are seen to be equivalent.

In exactly the same way the second law can be seen to be true in all cases by the truth table:

| A | B | $\bar{A}$ | $\bar{B}$ | A.B | $\overline{A.B}$ | $\bar{A}+\bar{B}$ |
|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 |

Again the truth values of the last two columns are identical, showing that the statement "NOT (A and B)" is logically equivalent to the statement "notA or notB".



*"OR" and "NOT" function demonstrators constructed along similar lines to the "AND" gate shown earlier in the article, and equally suitable for lectures and demonstrations. The "OR" demonstrator is wired up according to figure 2; the "NOT" unit is simply a switch wired in series with lamp and battery (switch "off" is "1").*

Consider now the situation represented by the following logic diagram:

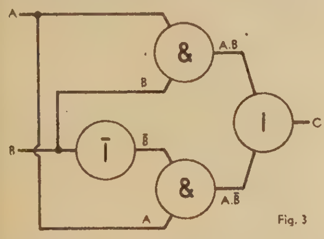


Fig. 3

The equation representing this situation may be written

$$(A\ .\ B)+(A\ .\ \bar{B})=C \quad \ldots (5)$$

If you look at either the diagram or the equation for a moment you will see that the elementary term "B" is actually redundant. This is because the output can be true both when B is true or when B is false and its complement is true. In fact, in such a situation the output is solely dependant upon the truth of the elementary statement A. When A is true, the output is true, and when A is false the output is also false. The output is **logically equivalent to A**, in other words, and so we may write

$$(A\ .\ B)+(A\ .\ \bar{B})=A \quad \ldots (6)$$

And we can verify that this is a general truth by means of a truth table:

| A | B | $\bar{B}$ | A.B | A.$\bar{B}$ | (A.B)+(A.$\bar{B}$) |
|---|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 |

As expected, the first and last columns have identical values, showing that the two statements concerned are logically equivalent.

It should now be clear that the four operations shown in figure 3 are in fact redundant; this is because the output which we called "C" is in fact equivalent to input "A". The diagram is thus equivalent to a simple "connection" between the output and input "A".

Equation (6) expresses one of two general truths which are known as the "laws of expansion." The other law of expansion is expressed in the equation

$$(A+B)\ .\ (A+\bar{B})=A \quad \ldots (7)$$

This expresses a situation very similar to the one which we have just considered. Figure 4 shows the corresponding logic diagram. Again it may be seen that the elementary term "B" is redundant and that the four operations are simply equivalent to a "connection" between output and input "A." The reader himself may care to verify this result by drawing up the corresponding truth table.

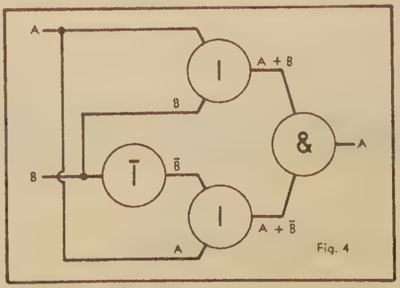


Fig. 4

As we shall see in the next article the laws of duality (deMorgan's theorem) and the laws of expansion play an important part in the technique of

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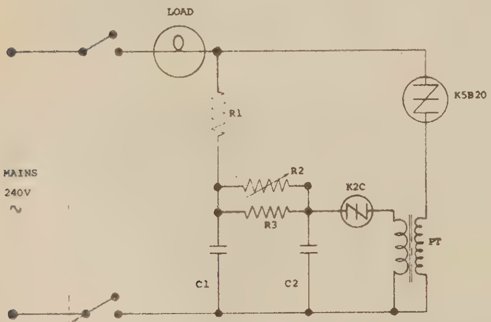

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C1 —0.1uF
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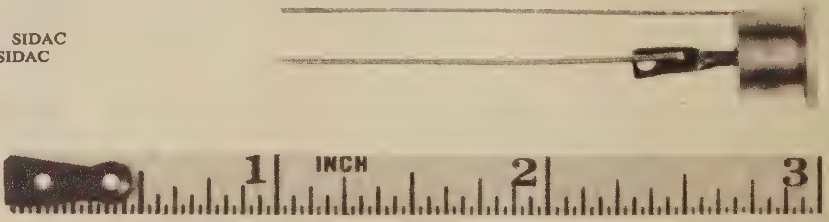

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"minimalisation": finding the minimum number of circuit elements which will perform a desired operation. This follows from their ability to indicate if any of the constituent basic operations are redundant, as in cases like the situations shown in figures 3 and 4.

For the present, however, let us consider a few more of the properties of our basic operations or "functions". For brevity, we will express the remaining properties by equations only; the reader may care to verify them for himself by drawing logic diagrams and truth tables.

The "laws of tautology" point out that the logical sum OR or the logical product AND of two identical terms is equivalent to either input:

$$A+A=A \qquad \ldots (8)$$

$$\text{and } A\,.\,A=A \qquad \ldots (9)$$

In other words, there is no need to add a statement to itself ("A or A") or to "square" a statement ("A and A"). In both cases, the output is simply the same as the input (see figure 5).

The "laws of commutation" point out that the order of terms makes no difference in either the AND or OR operations:

$$A+B=B+A \qquad \ldots (10)$$

$$\text{and } A\,.\,B=B\,.\,A \qquad \ldots (11)$$

i.e., "A or B" is the same as "B or A" and so on.

The "laws of association" show that the order of carrying out consecutive operations of the same type is unimportant:

$$(A+B)+C=A+(B+C) \qquad \ldots (12)$$

$$\text{and } (A\,.\,B)\,.\,C=A\,.\,(B\,.\,C) \qquad \ldots (13)$$

The "laws of distribution" show that the AND and OR operations are distributive over each other:

$$A+(B\,.\,C)=(A+B)\,.\,(A+C) \qquad \ldots (14)$$

and

$$A\,.\,(B+C)=(A\,.\,B)+(A\,.\,C) \qquad \ldots (15)$$

The "laws of absorption" show that either a sum (OR) or product (AND) in which the terms contain a common statement is equivalent to the common term

$$A+(A\,.\,B)=A \qquad \ldots (16)$$

$$\text{and } A\,.\,(A+B)=A \qquad \ldots (17)$$

The "law of double negation" is simply a formal statement of the truism that a statement is the complement of its complement, or that double negation restores a statement to its original value:

$$A=\text{not } (\overline{A}) \qquad \ldots (18)$$

The final three sets of laws depend upon the fact that the symbol "1" may be used to signify a statement which is always true and the symbol "0" to signify a statement that is always false.

The "laws of the universe class" show that the output of a sum (OR) in which one term is always true is also always true, and that the output of a product (AND) in which one term is always true is equivalent to the other input term:

$$A+1=1 \qquad \ldots (19)$$

$$\text{and } A\,.\,1=A \qquad \ldots (20)$$

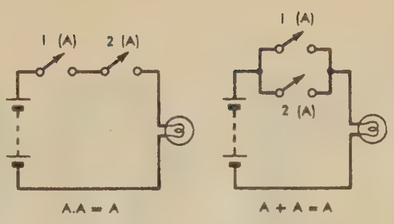

*Figure 5: The "laws of tautology" show that in both the AND and OR operations, duplicate terms become redundant. In both diagrams above, as both switches must be closed to represent the truth of "A", they are equivalent to a single switch.*

Conversely, the "laws of the null class" show that the output of a sum (OR) in which one term is always false is equivalent to the other input term, and that the output of a product (AND) in which one term is always false is itself always false:

$$A+0=A \qquad \ldots (21)$$

$$\text{and } A\,.\,0=0 \qquad \ldots (22)$$

And, finally, the "laws of complementation" show that the sum (OR) of a term and its complement is always true (i.e., either a term or its complement must be true), and that the product (AND) of a term and its complement is always false (because both can't be true):

$$A+\overline{A}=1 \qquad \ldots (23)$$

$$\text{and } A\,.\,\overline{A}=0 \qquad \ldots (24)$$

**(To be continued)**

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**Then there's the confidence of owning the most highly acclaimed turntable in audio history . . . the first automatic ever awarded unqualified approval by high fidelity experts for use in even the finest music systems . . . including their own.**

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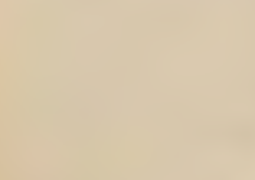
Precision Tonearm Balance



Lightweight tracking demands utmost perfection in tonearm balance. Dual achieves it with fine-thread adjust with nylon-braking, (no click stops) that takes full advantage of the virtually frictionless tonearm pivot bearing (under 0.1 gram).

A further refinement: complete isolation of the counter balance in rubber, reducing tonearm resonance below cps.

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Tracking force is induced with the same high degree of precision, by a long, mutliple-coiled mainspring, regulated by direct dial stylus force adjust. The numeral readings are accurate to within 0.1 gram. And because the tracking force i applied arcund the pivot, the tonearm maintains its perfect balance in all planes.

**DUAL 1019**

**DUAL 1009**

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**6% Variable Pitch-Control for All 4 Speeds**

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**Automatic Start in Single Play and Changer Operation**

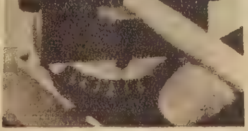
A great convenience feature is the 1009's fully automatic start in both single play and changer operation. And, of course, there is unrestricted manual flexibility as well. During play, the tonearm is completely free-floating and may even be restrained at any time during cycling, without concern for possible malfunction or actual damage . . . thanks to Dual's exclusive slip clutch.

Other exclusive 1009 precision features include: Elevator-Action Changer spindle that gently lifts all records, separating the bottom one so that no weight rests on it when it lowers; advanced Continuous-Pole Motor that maintains speed accuracy within 0.1% even when line voltage varies = 10% feather touch side switches for effortless operation; built-in anti-skating compensation for one-gram tracking; massive 7½ lb. dynametically balanced, non-ferrous turntable.

## *Now . . . why consider spending more for the 1019?*

**For still further Dual achievements of such significance that they enable the remarkable new Dual 1019 to close the gap with perfection itself. Many will feel that these advances are well worth the modest additional cost.**

**Direct Dial, Continuously Variable Anti-Skating Compensation**



So accurate you can actually balance the stylus force **in the groove:** Result: complete elimination of distortion from unbalanced tracking at the program source itself. Even more nportant: an end to uneven wear, not only on the inner groove of the record, but on the stylus itself! Anti-skating is applied to the tonearm around the pivot and in the horizontal plane, directly counter to the direction of skating. There is virtually no increase in bearing friction . . . a phenomally low 0.04 gram in the horizontal plane. Compensation is dialled just as one dials stylus force, so that numerals on both direct-reading scales correspond exactly.

**Feather-Touch Cue Control for Manual and Automatic Play**

Cueing as it should be . . . precise and convenient . . . dead-centre on the exact groove intended. Just a flick of the Cue Control lowers the tonearm smoothly, without a trace of vibration, no side shift of stylus anywhere on the record. When you stop on a note, you start again on the self same note! What's more, Cue Control also operates with fully automatic start for a slower-than-normal descent, as may be desired with high compliance styli, and automatically disengages. And cueing height is variable over a 3/8" range, to suit personal preference or to adjust for various cartridge heights.

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The 1019's spindle actually locks into the platter and rotates with the record, exactly as with conventional single play turntables. Thus does Dual answer the purist's last remaining argument.

And then there's even more! Cartridge holder adjusts for optimum stylus overhang; a "pause" position on the resting post for placing the tonearm without shutting off motor (very handy when flipping discs); concave platter mat to support records at their widest diameters (even badly warped discs won't slip), plus **all the precision features of the 1009!**

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| E5K3 | 5 | 5000 | S.E. | 3 |
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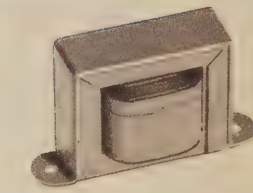

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Coil Width 1 5/16in.
Mounting Centres 2 1/16in.

| | | | | |
|---|---|---|---|---|
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| K7K3 | 6 | 7000 | S.E. | 3 |
| K5K3 | 6 | 5000 | S.E. | 3 |
| K10K15 | 6 | 10000 | S.E. | 15 |
| K7K15 | 6 | 7000 | S.E. | 15 |
| K5K15 | 6 | 5000 | S.E. | 15 |

| | | | | |
|---|---|---|---|---|
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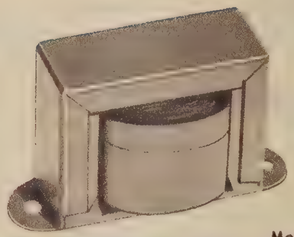
| K10KT15 | 9 | 10000 | P.P. | 15 |



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**KKT SERIES**

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| | | | | |
|---|---|---|---|---|
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| B5K15 | 8 | 5000 | S.E. | 15 |

| | | | | |
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Here is a simple, light-weight, economical, regulated power supply ideally suited to the experimenter who needs only moderate orders of current. It also has its place in workshops and laboratories as a back up unit for larger supplies, the total capability of which may not always be needed.

In a past issue (March 1960) we described a regulated variable power supply with a high current capability. This unit turned out to be a real laboratory workhorse and is still doing a full-time job after six years of hard work. In fact, recent demands on it have been heavy enough to suggest that the time had come to build another one.

However, we had noticed that a significant proportion of the total jobs did not involve very high current requirements. We reasoned, therefore, that a smaller, lighter, and simpler unit might be all that was needed to supplement the large one. At the same time it would give us an opportunity to investigate the design of such a unit which, we felt sure, would appeal to a large number of readers who felt that the expense and complexity of a larger unit could not be justified.

As a final compromise between all the factors, we settled for a HT current of 40mA, a voltage range from 190 to 270 volts with maximum regulation—but capable of being extended with some loss of control — plus a 6.3V heater winding.

Finding a power transformer to suit our needs presented something of a minor problem. We needed a 40mA rating—no larger since this would present space problems—and two 6.3V heater windings, one for the voltage regulator system and one for the external terminals. Separate windings are essential, since the heater supply for the regulator valve cannot be connected to chassis without transgressing the heater-cathode voltage ratings of the valve.

We also had in mind using a conventional voltage doubler system, using silicon diodes, in preference to the more bulky and less efficient valve rectifier system. Unfortunately, we could find no transformer which would satisfy all these requirements. The nearest turned out to be a 285 a side, centre tapped secondary type.

While it would have been theoretically possible to use silicon diodes in such a circuit, the higher voltage would have made it necessary to employ two such units in series in each leg, in order to handle the voltage. Economically, this was not justified in comparison with the low cost of a 6X4 valve rectifier.

For those unfamiliar with regulated, variable power supplies, the following description should prove helpful. The power transformer and associated rectifier and filter circuit are quite standard, and should need no further explanation. However, we have drawn a simplified circuit of the regulator section to assist the explanation.

Proceeding from left to right on the simplified circuit, it will be seen to consist of a series of voltage divider networks. The first network consists of the 100K resistor and the neon bulb in series. Because of the self compensating properties of the neon bulb, the voltage at the junction of the 100K resistor and the neon will remain essentially constant, over a wide range of current values drawn from this point.

The purpose of this divider is to provide bias for V1, in the form of a positive voltage applied to its cathode. And, since we are dealing with DC signals rather than AC, as encountered in more conventional amplifiers, the neon lamp, or something like it, is the only satisfactory method of providing a stable bias voltage. We could use a battery, and it would work just as well, but would be inconvenient for obvious reasons.

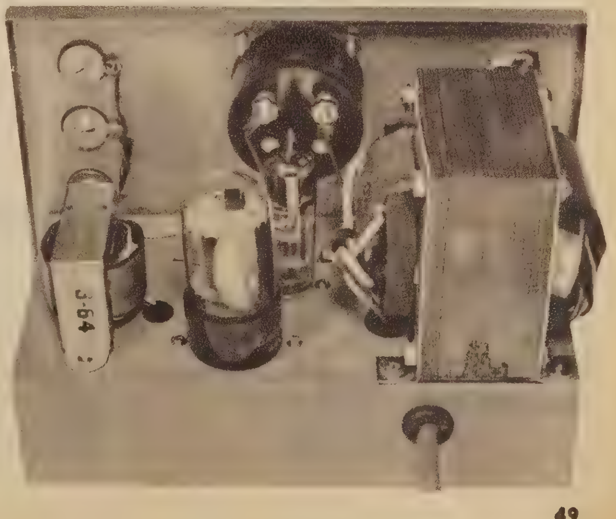
The exact value of the bias voltage thus generated is not particularly critical, since the grid of V1 is connected to a source of variable positive voltage which, in the first instance, serves to place the grid at a lower positive potential than the cathode, thus making it negative with respect to the latter.

The second voltage divider consists of the 220K resistor, V1, and (again) the neon lamp. Its purpose is to provide a voltage tap (between V1 plate and the 220K resistor) for V2 grid.

A third divider, and the most important in many ways, consists of V2 and whatever load is connected to the power supply. This is shown as a resistor, Rl, in the circuit. Another network, the 1M pot and 220K resistor to chassis—which may be regarded as yet another voltage divider network in its own right—forms part of the third divider, by being connected in parallel with the load. However, this point is not particularly important in regard to the functioning of the third divider.

The purpose of the third divider is the fundamental one of controlling the voltage across the load, Rl. One way of

*The layout of all the major components is clearly shown in this photograph. The neon indicator light, which is also the bias voltage stabiliser, is just visible on the front panel behind the power transformer.*



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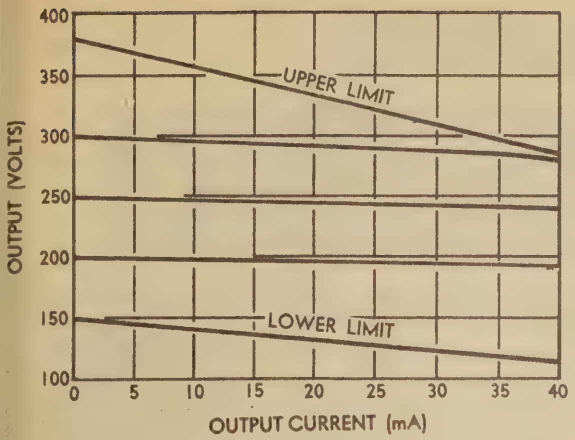
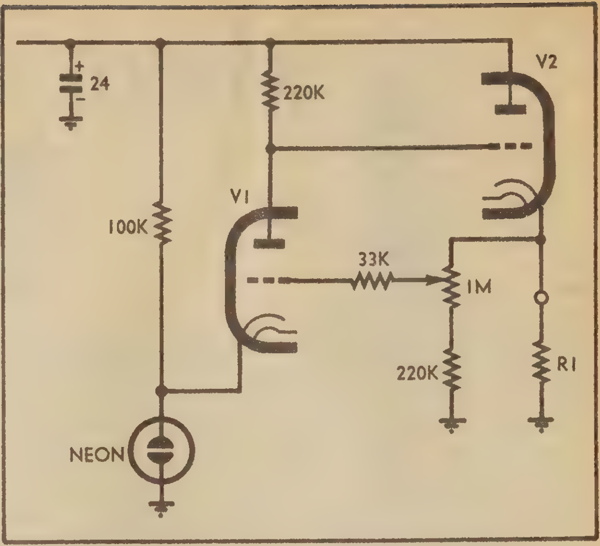


*The regulation curves shown above indicate the performance which may be expected from our regulated power supply. Note that good regulation cannot be expected when pushed to the two limits but can be expected between 180 and 260 volts.*



*Simplified diagram illustrating voltage regulator action, as explained in the text.*

visualising this function is to regard V2 as a variable resistor in series with Rl as a fixed resistor. The resistance of V2 may be varied by varying its operating conditions (grid bias, for example) and, as it varies, the voltage distribution across it and Rl will also vary.

Alternatively, it may be regarded as analogous to a hydraulic valve in a pipe line, used to control the rate of fluid (current) flow in the remainder of the system. By controlling the current in Rl we must, automatically, control the voltage across it since, by Ohm's law, these two will be in direct proportion. Either way, it should not be hard to visualise how this part of the circuit functions.

Having thus established how V2 controls the voltage across the load, let us now work back through the circuit and determine how the operating conditions of V2 are controlled and, in particular, how they are made to respond to changes in mains voltage or load, so as to maintain a constant voltage.

V2 is controlled by V1 which, in conjunction with the 220K plate load resistor, functions as a variable voltage divider to vary the bias applied to V2. V1 may be regarded as a D.C. amplifier which samples the output voltage—across the 1M/220K voltage divider network—amplifies any changes and applies a correction signal to V2 aimed at restoring the original condition.

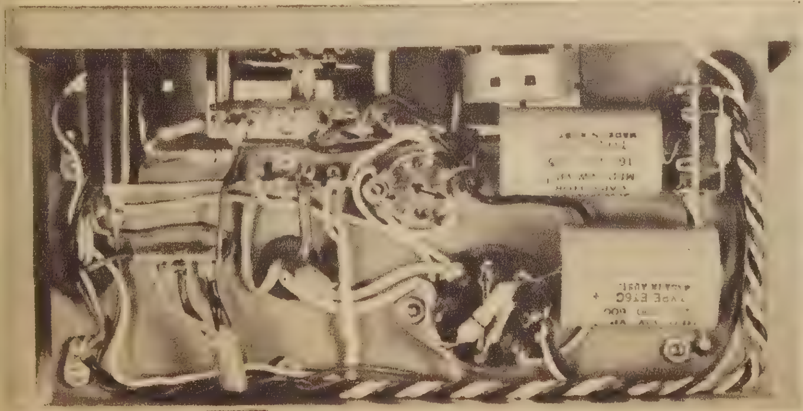
For example, let us imagine that the moving arm of the 1M pot is at its mid-position. The voltage applied between grid and cathode of V1 will allow a certain amount of current to flow through the 220K plate load resistor. This will set the value of voltage appearing at the plate of V1 and therefore the voltage applied to the control grid of V2.

A set of typical figures for such a situation, taken from our own unit, is shown on the diagram. These are all positive voltages, measured with respect to chassis. Note the voltage differences between grid and cathode of both V1 and V2.

If the pot is now turned towards the 220K resistor the positive voltage on V1 grid will be reduced and, since V1 cathode voltage remains constant, there will be, effectively, an increase in voltage between grid and cathode, the grid being negative.

This will cause a decrease in current through V1, a decrease in current through the 220K resistor, and a decrease in the voltage across the 220K resistor. This latter action will cause the grid of V2 to move towards the main H.T. line, or to become more positive with respect to chassis. This is equivalent to decreasing the grid-cathode bias on V2, which will increase the current flow through it, and through the load, thus resulting in an increased voltage across the load.

In this manner, by manual operation, we are able to vary the output voltage of the supply across a constant load.



*Underchassis view showing minor components and valve socket orientation. Note that a strain clamp was fitted to the power cable after this picture was taken.*

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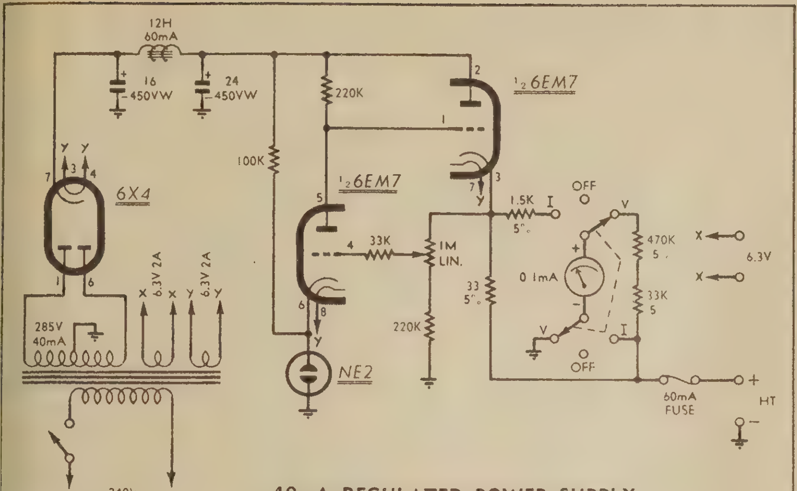

40mA REGULATED POWER SUPPLY

*The complete circuit. The power supply proper is quite conventional and the regulator section is similar to the simple circuit on the previous page. The metering circuit uses the standard five per cent resistors as shunts and multipliers.*

But, by the same token, if the pot ad not been adjusted manually, and he output voltage had changed for some other reason, such as a change in load esistor value, or a mains fluctuation, xactly the same sequence of events vould have taken place. This, then, is he basis for the all important voltage egulation characteristics which is the main feature of the device.

Note, however, that no feedback ystem can ever completely compensate or such variations. To assume that the riginal voltage is fully restored is to ssume the ridiculous situation whereby he circuit is able to compensate itself vithout there being any change of voltge into the feedback system. In fact, here must always be some variation n order that correction may be initiated nd maintained, but the feedback system can reduce the variation to only a ny fraction of what it would otherwise e.

Naturally, at the extreme limits of he output voltage, the regulation falls ff. However, within these limits it is ery good and, in this particular version, he voltage variation is only 4 pc from no oad to the full load of 40mA. The accompanying set of curves shows the performance in greater detail.

Briefly, for extremely good regulation the output voltages should be set between 180 and 260 volts, which includes the majority of operating voltages normally required. Fair regulation is still available at 175 and 300 volts but beyond these figures the regulation falls off rapidly.

So much, then, for the theory of operation and the standard of performance to expect from such a supply. Let us now look at the practical design.

Construction is relatively simple, and most of the details are shown in the accompanying photographs. The unit is housed in our new small instrument case, fitted with a simple "U" shaped aluminium chassis. There is plenty of room for the few components involved.

To monitor the voltage without the inconvenience of a separate multimeter, a metering system was built into the power supply. This was designed around a cheap 1mA meter movement. We re-scaled the dial to read 0 to 5 which could then be read as 0 to 50mA or 0 to 500V depending on the meter selec-

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*1 12H, 60mA filter choke.*
*1 7-pin miniature valve socket.*
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*1 6EM7 valve.*
*1 6X4 valve.*
*1 NE-2 neon.*
*1 Bezel to suit neon.*
*1 Cartridge fuse holder.*
*1 60mA cartridge fuse.*
*1 2-pole, 3-position switch.*
*1 On/off toggle switch.*
*4 Terminals.*
*1 3-lug tagstrip, miniature.*
*1 4-lug tagstrip, miniature.*
*1 5-lug tagstrip, miniature.*
*1 3-lug tagstrip, standard.*
*1 1 megohm linear potentiometer.*
*1 Length of 3-core power flex.*
*1 3-pin plug.*
*1 16uF, 450VW pigtail electrolytic.*
*1 24uF, 450VW pigtail electrolytic.*

*Resistors, (½W).*

*1 33, 5%.*
*1 1500, 5%.*
*1 33K, 5%.*
*1 33K.*
*1 100K.*
*2 220K.*
*1 470K, 5%.*

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*Screws, nuts, solder lugs, tinned copper wire, hookup wire, solder, grommets, etc.*

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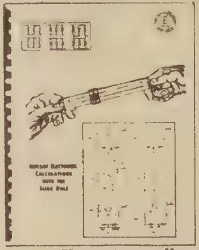

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tion switch. To avoid the cost of meter shunts we used a small resistor in series with the power supply and read the voltage drop across it.

A multiplier resistor was then chosen to give full scale deflection when 50mA was flowing through the series resistor. In our prototype we used two 5 per cent resistors for this current reading, the series resistor being 33 ohms and the multiplier resistor 1500 ohms. Normally a 1mA meter, with an internal resistance of 100 ohms, would require slightly less than 1500 ohms. However we found that the above combination was as accurate as the reading capability of the small meter scale used.

The same applies to the voltage scale used in our power supply, the scale read-out being the limiting factor for the accuracy of the multipliers. The two multiplier resistors, 470K and 33K in series, were both 5 per cent tolerance and cheaper than a special 1 per cent meter multiplier.

The meter switch has three positions, the centre position allowing the meter to be removed from the circuit. A two-position switch could be used but it would be essential to use a non-shorting type wafer otherwise the meter could be damaged when changing ranges. Spare contacts on the unused section of the wafer switch were used to support the multiplier resistors.

The bias stabilising neon lamp is made to do double duty as an "On-Off" indicator, by mounting in a suitable bezel on the front panel. The lamp is supported on a small tagstrip anchored under one of the transformer lamination bolts.

On loads heavier than 40mA the output will drop quickly and protection of the power supply from short-circuit loads is afforded by a 60mA fuse in series with the output terminals. When applying an unknown load to the power supply the meter switch should initially be set to "Off" or "Voltage." This is to protect the meter from overload. However, should the meter be left in the "Current" position it is unlikely that any permanent damage will be caused by an overload as the output will drop as mentioned above before such damage can occur.

Higher current capabilities could be achieved in a similar power supply by using a heavier transformer and a pair of 6EM7 valves in parallel. We will probably investigate this system at a later date.

The power cord terminates on a three-lug tagstrip. Not shown in the underneath view is a clamp around the power cord which is anchored under the power transformer mounting screw. This clamp was added after the photograph was taken and ensures that an accident tug on the power cord will not cau damage to the cord and/or a sho circuit on the mains supply.

When wiring the control potentiomet the tag which is normally regarded a the earthy tag in volume control practic is the one which should connect to th high-tension line. Otherwise when th control is turned clockwise the outpu voltage will fall.

Also remember that the filaments o the two valves should NOT be returne to chassis, as the cathode heater ratin of the 6EM7 will be exceeded wit possible damage to the valve and oth components. The correct pins for wirin the 6EM7 valve are shown in the wirin diagram and this should be followe carefully. A reversal of the two triod sections will render the supply useless.

The power transformer should n overhang the chassis or it will be im possible to fit the unit into the instru ment case. We feel it is necessary t completely enclose an instrument of thi kind and so reduce the possibility o accidental shock.

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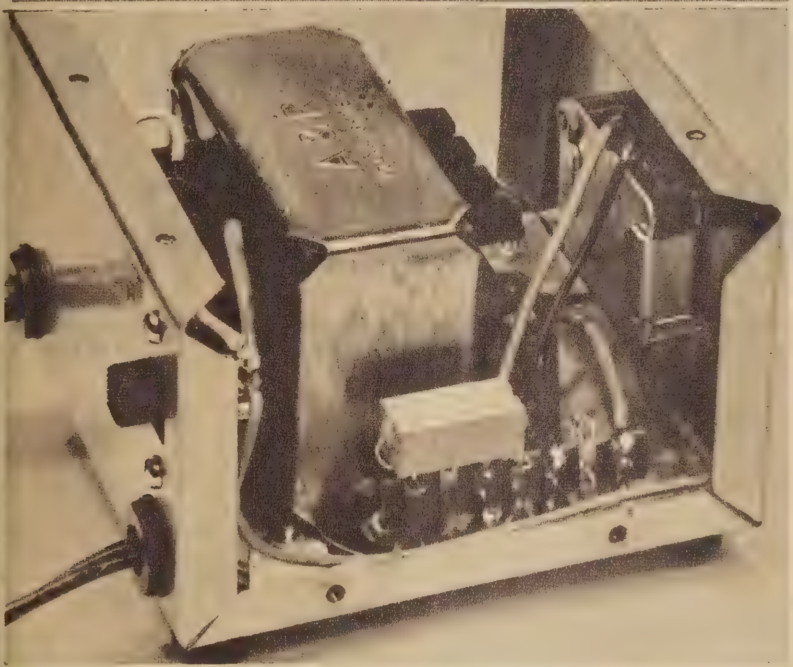
# BATTERY CHARGER — 1A VERSION



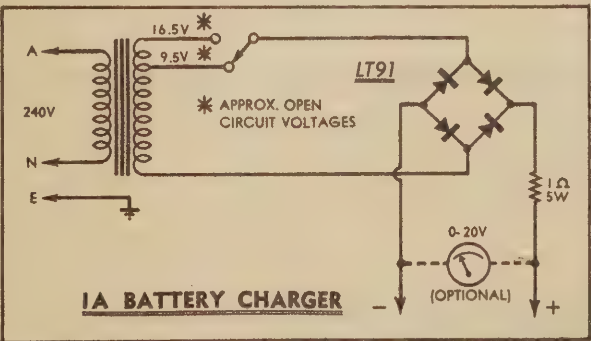
Following our description last month of a small charger for car batteries, we have had an opportunity to try another transformer in the same set-up. This unit was submitted to us by A & R Transformers Pty. Ltd. and has a nominal rating of 1A. It is also designed so that the core tends to saturate at higher values, thus providing a measure of overload protection.

Physically, it is slightly larger than the Ferguson model used in last month's version, but there was no difficulty in accommodating it in either of the metal boxes we mentioned in that article.

The transformer manufacturer recommends a 1 ohm ballast for use with this model. Assuming a charging rate of 1A, the wattage dissipation would be 1W, but it is advisable to allow some margin for higher rates which may sometimes occur—briefly —when a battery is well discharged, and also because the resistor is not operating in "free air" conditions. A 3W type should be adequate.

With this value of ballast, the charging rate was approximately 1A into a 12V battery and 0.8A into a 6V battery. Deliberately operated into the 10V and 4V sections of the 12 and 6V batteries—to simulate severely discharged batteries—it produced rates of 1.4A and 1.3A respectively. With a rectifier rating of 1.5A, and allowing that some short term overload should not distress the transformer unduly, the value of ballast and the general operating conditions appear to be quite satisfactory.

However, it should be appreciated that there is less margin for error with this version than last month's, if only because the rectifier is now working closer to its maximum rating. Such tricks, therefore, as charging 6V batteries from the 12V circuit, as mentioned last month, should be strictly avoided. ◼



1A BATTERY CHARGER

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The experiment is to see whether a device which would provide communication between such persons and a nearby neighbour will help in an emergency. ("Electronics Weekly").

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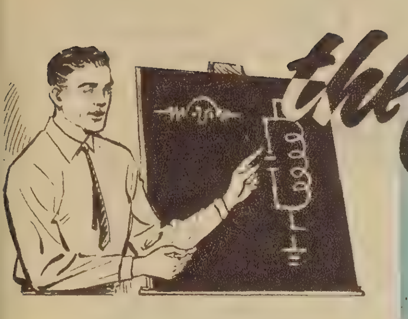


# the "Answer Man" Explains

## What's wrong with good old "cycles"?

Hard on the heels of the change in transistor symbols, mentioned in our last issue, comes a letter from a reader inquiring about the symbol "Hz" which he has noted in some overseas journals. Possibly other readers have wondered about it also.

**An American radio magazine, which I see fairly regularly, seems to be using the term "Hz" quite a lot. To put it bluntly, "What's the big idea?"**

Well, we can't answer directly for the magazine concerned but we have a pretty good idea why they did so. In point of fact, there has been a certain amount of discussion among our own staff as to whether we should or should not do the same thing.

The symbol Hz is an abbreviation of Hertz, which you will doubtless recognise as the name of one of the famous pioneers of the radio art. The term "Hertzian waves," meaning radio waves appears in many old textbooks.

For years, European continental practice has been to use the term "Hertz" to mean "cycles per second" and the abbreviation Hz has become more or less established in European radio literature.

There is plenty of precedent, of course, for so using the name of a radio pioneer. Our unit of resistance is the surname of George Simon Ohm; our unit of capacitance is the Farad (from Faraday) and of inductance the Henry. And so on.

Outside of Europe the term "cycles per second" has persisted, so that followers of international technical literature had to accept the terms Hertz and Hz, along with "cycles per second" and all its varied contractions.

In fact, contraction or abbreviation is one of the problems of the latter term.

In its full and correct form, the basic term and its multiples are "cycles per second," "kilocycles per second," "megacycles per second" and so on.

All these represent quite a mouthful to say and a "lineful" to print. Not surprisingly, they are very commonly contracted to cycles, kilocycles and megacycles — terms which rely for their validity on the assumption that everybody will naturally understand the "per second" part.

In reducing the terms to initial letters, a logical basis is the form of "c/s." It sounds simple until you begin to debate whether the basic quantities should have capital letters and whether it should more correctly be represented as "C/S."

When the decade multiples are introduced, the problem grows because there is argument also about the "K" and the "M."

So we find ourselves with c/s which looks neat enough but with the suspicion that it should really be C/S. Again Kc/s looks the neatest of the possible variations of this group but is it consistent to have the basic quantities in lower case letters?

Unfortunately, even Kc/s is a rather clumsy abbreviation in text containing a lot of frequencies and, if it is all right to talk about "kilocycles" why shouldn't it be all right to adopt the much neater abbrevation "Kc"? But if you do this, what about cycles? Won't the simple "c" look rather lonely without a "K" or an "M"?

This has given rise to fairly common use of "cps" without its logical expansion into Kcps and Mcps.

And, if that's not enough, a decision has to be made as to whether the abbreviation should be set close up on the figure (465Kc) or separated (465 Kc) or followed by a full point 465 Kc.) or so on.

To the casual reader, all this may seem like "much ado about nothing" but this is far from the case. When a large number of writers are preparing copy for a magazine, it's all too easy for some of them to use their own abbreviations, which may escape the notice of the sub-editor and be set up in metal.

Or again, a compositor, who spends much of his time setting ordinary newspaper or magazine copy, according to "house" style, may carry right on applying the same rules to technical copy.

And when an article is set up in metal type, full of non-standard abbreviations, it's a costly and time wasting business to go through it and reset lines.

The term Hertz avoids at least some of these problems because Hertz means cycles per second. We are thus left with the abbreviations Hz, KHz and MHz as a fairly consistent group.

Whatever the reasoning behind it, however, the U.S. National Bureau of Standards has now adopted the term Hertz (and Hz) and it is appearing in more and more U.S. publications and reports.

Maybe the time is approaching when we should do a count of heads, as it were, and see whether we shouldn't follow suit.

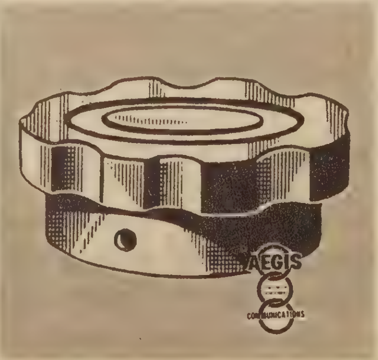
Inevitably there will be some who won't like the idea, because a break with tradition so often Hertz!

* * *

**I recently read a book in which several methods of communication were discussed. Among these was signalling by telegraphy and a frequently used term was "the baud." What is a baud?**

A concise explanation of this term was contained in a recent discussion of telegraphic equipment and facilities, published in the English journal, "Electronics Weekly." It appealed to us as being an ideal answer to your question, and one with which you are not likely to become "bored."

Telegraph and data transmission rates



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are sometimes quoted in bauds, or in bits per second (b/s), or in characters per second, or in words per minute. The connection between these terms and the bandwidth of the circuit is explained below.

It is necessary to go back to the old Morse dot for this explanation. This comprises a mark element followed by a space element of the same duration, each being the shortest modulation element in the system. One complete Morse dot of a mark plus a space is called a keying cycle. If 50 dots are keyed per second, the transmission has 100 modulation elements and this is termed 100 bauds or 100 bits/second. Bit is an abbreviation for "binary digit."

How many characters and words this represents clearly depends upon the telegraph or binary code being used. With the conventional five-unit teleprinter code, 50 bauds is usually taken to be about 7.5 characters per second, and 400 characters or roughly 66 words per minute. Similarly, 600 bauds is about 90 characters per second. But if each character requires more modulation elements, such as the eight-level code, 600 bauds would be only about 70 characters per second.

The bandwidth needed to carry information at a given rate depends not only upon the keying speed and the coding efficiency, but also on the signal-to-noise ratio of the transmission medium.

But in practical terms, a 50-baud telegraph channel represents roughly 120 cps bandwidth.

And on telephone circuits, due to the need to avoid using certain frequencies, we are limited to roughly 600 or 1,200 bauds depending upon the characteristics of the line, even though much higher speeds are theoretically possible.

On Telex we use a whole 3-4KC telephone channel for 50 baud working, although by FM/VF multiplex techniques some 15 teleprinter channels can be carried on such a circuit.

For data transmission up to about 1,200 bauds, frequency modulation (FSK) systems are generally used — above this speed phase modulation and compound techniques such as Kineplex have proved very effective.

The U.K. GPO Datel services currently include the Datel 100 (up to 100 baud) and Datel 600 (600 or 1,200 baud) with optional 75 baud return channel. Soon to be introduced will be the Datel 200 and Datel 300 services for 200 and 300 baud transmission. The GPO Data Transmission Set 1A is a modem for use with the Datel 600 service. Error detection units are available from the GPO for the Datel 100 service. Specially equalised circuits capable of speeds up to 2,400 bits/second (i.e. 2,400 bauds) can be rented.

* * *

**What is the meaning of the word "modem" used in the previous explanation?**

According to the Australian P.M.G.'s Department, "modem" is derived from two words; "MOdulating" and "DEModulating." In order to understand it fully we must take a closer look at the modern practice of using telephone lines to handle digital data signals from a wide and ever increasing variety of sources.

A typical application might involve a central computer and a number of remote offices—ranging from suburban to world wide—equipped with desk sets by means of which office staff can feed information into the computer, or interrogate it and receive information it has in store. Seat booking facilities as used by airlines and other transport organisations are typical examples.

Digital data pulses as generated by, say, the desk set, are DC pulses, such as produced by the simple opening and closing of contacts. Similarly, the pulses generated by the computer and used to display information on the desk set would also be of this nature.

In certain cases it is perfectly practical to transmit these DC pulses directly over "metallic circuits," as might be provided by the P.M.G.'s Department, on request, for relatively short range working, such as within the metropolitan area.

However, it is considered that ordinary telephone subscribers may soon wish to transmit digital data over ordinary telephone circuits, the connection being established by the subscriber dialling the wanted number in the ordinary way and then, having satisfied himself that the correct number has been connected, switching to data transmission.

This is where the modem is required. The ordinary telephone circuit is not necessarily "metallic," i.e., it may well provide only "AC coupling" with no provision to handle DC pulses. This is particularly so where long distance trunk lines are involved, and which may employ carrier systems, microwave links, or combinations of these. And even within some Australian metropolitan areas carrier systems are used for trunk lines between exchanges, while microwave links are being considered in this role.

It is therefore necessary to convert DC pluses to a series of AC pulses, or tones, which any telephone circuit can handle. This is done by causing the DC signal to "modulate" a tone generator, thus accounting for the "mo" portion of the new word.

At the receiving end of the line a similar, but reverse, situation exists. The tones which are received cannot be used directly to operate the various mechanisms of digital data equipment. They must be reconverted to DC.

This is achieved in much the same manner as in a conventional radio receiver where a detector (rectifier) is used to demodulate the modulated RF carrier. The only real difference is the frequencies involved. Thus we have a "demodulating" function which accounts for the second part of the word.

* * *

**Would you please tell me how to calculate the variable resistance value needed to control two 20 watt, 12 volt globes? Also, what wattage rating would such a resistor need?**

Because this question, and the answer we were able to provide, was such an excellent example of the practical use of "Ohm's law," we felt that other readers would like to study it. It should appeal particularly to those who can remember Ohm's law easily enough, but find themselves at a loss when it comes to the practical application.

In fact, the problem involves two standard electrical laws. One, as already mentioned, is Ohm's law, which states that the voltage across a resistor is equal to the resistance in ohms multiplied by the current through the resistor.

The other law states that power in watts is equal to the product of voltage and current.

Step number one: Determine the current drawn by both lamps when operating at full voltage. We do this by transposing the second law so that it reads $I=W/E$, where I is current in amps, W is power in watts, and E is pressure in volts.

Substituting figures we get: $I=20/12$, or 1.66 amps per lamp. Since there are two lamps in parallel, the total current is 3.32A.

Step number two: Decide at what voltage the lamps will cease to glow. This will vary with operating voltage and types of lamps, but a good basis for calculation is one quarter of the rated voltage, or 3V in this case.

Another factor which is not as precise as we would like it to be is the resistance of the lamps at varying voltages. Normal resistors are essentially "linear" devices, in that the resistance remains constant for any normal value of applied voltage. Lamps, on the other hand, are "non-linear" resistors; their resistance is low when the filament is cold, and rises—usually by a factor of several times—as the temperature rises to full operating value.

Thus we cannot state precisely what the resistance will be at voltages other than the maximum. However, if we proceed — initially — as if the lamps were linear and then, knowing the direction of the error, "add on a bit" we will arrive at a value close enough for practical purposes.

Step number three: Find the current through the lamps with 3V applied. Assuming the lamps were linear, reduction of the voltage to one quarter would reduce the current by the same factor. Thus, the new current could be expressed as 3.32/4, or .83A. However, the lamps will in fact draw more than this, so it is convenient to round the figure off to a whole number, say 1A.

Step number four: Determine the voltage which will be applied to the resistor, when 3V is applied to the lamps. This is simply 12-3, or 9V.

Step number five: Find the value of R across which 9V will be developed when 1A flows through it. Expressed as Ohm's law this becomes; R equal E/I, or $9/1 = 9$ ohms.

Finally, find the total wattage dissipated by the resistor. Since W equals E x I, 9 x 1, this will be 9W.

Thus we can say that the required resistor must have a value not less than 9 ohms and capable of dissipating at least 9 watts. In practice, it would be unwise to work to such close limits and some margin for safety should be allowed.

Depending on what was available commercially, a resistance value between 12 and 15 ohms would be a good choice. A wattage rating of 10 could be satisfactory, assuming that the manufacturer's rating was not an optimistic one and — most important — that the resistor was to be operated in "free air" conditions. If it was to be enclosed in any way, then it would be wise to double the rating. ■

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3666

# CALIBRATION TECHNIQUES and a Reference Crystal

### By Ian Pogson

100KC CRYSTAL REFERENCE

*Small enough to be held in one hand, this 100KC Crystal Reference may be used as a sub-standard for many applications. Some of these applications are covered in the accompanying article.*

Without delving into any other branch of electronics, in communications it is becoming more vital as time goes on to be sure that one is "on frequency." Again, without straying beyond the confines of amateur radio and the short-wave listener, one must be able to determine, with moderately high accuracy, the frequency in which one may be interested at any particular time.

This is of considerable importance in the case of the transmitting amateur, because the authorities rightly insist that transmissions must only be made within very definitely defined bands. And even the short-wave listener, if desirous of listening to a transmission on some predetermined frequency, must have a receiver which is accurately calibrated. Alternatively, he must have access to some accurate frequency reference, in order that he may check his receiver.

Where modern and, more particularly, factory built equipment is in use, it will normally be accurately calibrated anyway. Even so, a frequency reference in the form of a 100KC crystal oscillator may be built into the unit. This reference is then always available to check the maintenance of calibration of the receiver or transmitter.

On the other hand, if equipment, home built or ready-made, has no frequency reference, there is no reason why this state of affairs should continue. It is not necessary to have the reference built into the unit to be just as effective. Such a reference can be very simple and is not very expensive to build. In fact, if one happens to have a 100KC crystal tucked away, then the cost will be very moderate indeed.

The writer is currently investigating various types of transistor oscillator, with the idea of using at least some of them in pieces of equipment in the reasonably near future. Among these are some 100KC crystal oscillators of varying degrees of precision and complexity. It is proposed to take a couple of these in our stride and include some details so that they may be duplicated by readers who need one of the simpler versions for their own use. After having such a reference for a while, one wonders how it was done without in the past.

From some of the foregoing remarks, it must not be construed that transmitting amateurs need only a well-calibrated transmitter, with a 100KC crystal calibrator built in. While there is no denying the excellence of modern equipment as regards frequency calibration, the authorities also require that a satisfactory heterodyne frequency meter shall be maintained by the licensee.

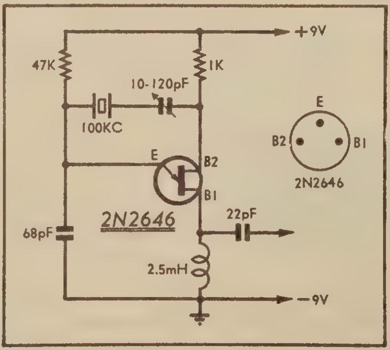
A relatively recent development in the field of semi-conductors is the unijunction transistor and, among other applications, it has possibilities as a low frequency oscillator. Its use and operation were described in the article on a Low-Cost Morse Practice Set, which appeared in the February, 1966, issue.

For those readers who do not have access to this issue, we will run through the description of operation again briefly. Before doing so, we would point out that the type 2N2646 unijunction transistor to which we refer has an upper limit of oscillation somewhat above 100KC. There are other types which are capable of operation higher than this, but these are more expensive at the present time.

The circuit of a 100KC crystal oscillator using the 2N2646 unijunction transistor, which we have had operating, is shown on these pages.

The operation of this circuit depends upon the rather unique properties of the unijunction transistor. As its circuit symbol would suggest, the unijunction is a quite different device from normal two-junction transistors. In fact, it is closer to a diode than a transistor and has sometimes been called the "double-base diode."

In construction, the unijunction consists of either a small rectangular bar or cube of N-type silicon material, with a non-rectifying or "ohmic" connection at each end. The bar or cube is termed the "base" because of its similarity to the base wafer of a normal transistor and the two connections are labelled B1 and B2.



*Although we have not featured this circuit using the unijunction diode in our oscillator, such a simple configuration may well have possibilities in the near future, even so far as replacing more conventional circuits.*

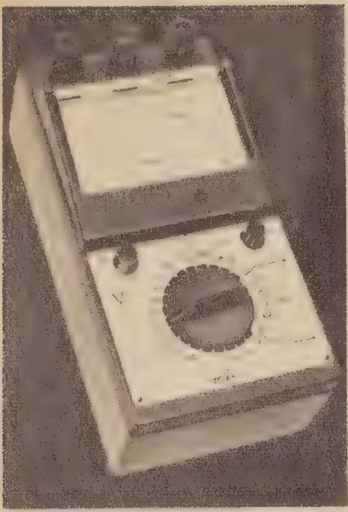
To the side of the bar or cube between the two base conections is alloyed a pellet of P-type silicon material, forming a single P-N junction — hence the name "unijunction." The P-type pellet is called the emitter and its connection labelled E.

Either of the two base connections of the unijunction may be used together with the emitter connection as a normal rectifier diode, which will conduct if the emitter is made more positive than the base, but will become a virtual open-circuit if the base is more positive than the emitter. However, a voltage applied across the base by making B2 positive with respect to B1 gives the emitter-base P-N junction an inbuilt "delay bias."

This is because current flowing through the base from B2 to B1 sets up a voltage drop in the N-type material and raises the potential of the base region in the immediate vicinity of the junction. Thus, as far as the emitter is concerned, the base becomes positively biased, and conduction through the junction cannot take place until the emitter is raised above the effective base potential.

But the unijunction is more than a diode with "built-in" bias, for as soon as the emitter is raised above the effective base bias potential to start conduction through the junction, it injects minority carriers (holes) into the N-type base material. These have the effect of increasing markedly the conductivity of the base region between the junction and B1 and the resistance of this region drops sharply.

Because of the drop in resistance the current between B2 and B1 increases and current amplification occurs because the increase in B2-B1 current is considerably greater than the small



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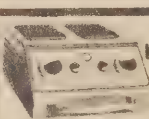

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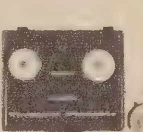

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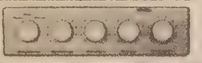

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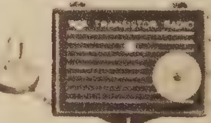

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emitter-base current. Not only this, but the fall in resistance of the junction-B1 region produces a falling voltage with INCREASING emitter-base current — so that the effective input resistance of the emitter-base junction is NEGATIVE.

Because of its ability to act as a high current-gain switch and as a negative resistance the unijunction is finding increasing use in triggering and relay circuits, in pulse shaping circuits and in many types of oscillator.

Referring again to the 100KC crystal oscillator using the 2N2646 unijunction, it will be seen that the circuit uses a bare minimum of components, even less than the simplest oscillator using one transistor. The crystal is connected between B2 and emitter and due to the operation of the unijunction, a phase shift of 180 degrees occurs between these elements. This combined with the amplification just described, maintains oscillation. The output is taken from B1.

The 68pF capacitor shown between the emitter and earth is not always necessary. However, this value may be included for most crystals, its effect being to increase the strength of oscillation somewhat, as well as lowering the frequency. If the capacitance is increased much beyond this value, oscillation can become erratic and outside the control of the crystal.

Adjustment of the crystal to correct frequency against a standard such as WWV, is done with the variable trimmer in series with the crystal. If it is not possible to bring the crystal to the correct frequency by this means, then t may be necessary to change the value of the 68pF capacitor.

With some crystals which we tried, n order to make the crystal approach zero beat with the standard, it was necessary to reduce the capacitance of he series trimmer to a very low value. Under these conditions, the crystal would either stop oscillating before zero beat was reached, or it would not start again after being switched off.

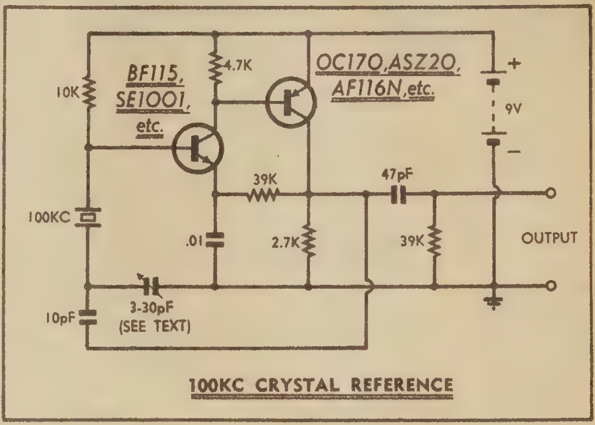
While some crystals performed very well in this circuit others could not be brought to correct frequency, and the ndications are that, in its present form, t is not universally satisfactory. For his reason, we have not featured this ircuit for all to use. However, for xperimentally inclined readers with a uitable crystal, we can recommend that his circuit be given a trial.

Having drawn this conclusion, we were still faced with the need for a imple approach to the 100KC crystal scillator. An oscillator which three of he staff of ELECTRONICS Australia contributed to developing, can be used n a number of applications and it has een proved to be capable of high tability performance.

Recently, Keith Woodward was in-estigating the possibility of developing transistor variable frequency oscillator long the lines of the Franklin. At the ame time, Jim Rowe suggested that e start with the DC stabilised two-age audio amplifier which we have sed in a number of recent applications. he suggestion continued with the idea f running a positive feedback loop om the collector of the output stage, the base of the input stage. A paral-l-tuned LC circuit could then be unted across the feedback loop.

The principle of operation is quite mple. With the positive feedback, the circuit will oscillate in a random fashion, determined by the circuit constants. However, when the parallel LC circuit is shunted across the feedback loop, the tuned circuit will offer a low impedance to all frequencies except at the frequency of resonance. Thus, the feedback loop is virtually short-circuited at all frequencies except that of the tuned circuit and so the complete circuit oscillates at this frequency. This will be recognised as the principle of operation of the Franklin oscillator.

*This is the circuit of the 100KC Crystal Reference. Developed in our own laboratory, a number of alternative transistors may be used with little if any difference in performance. It should be noted however, that NPN and PNP types should be used in the first and second stages respectively.*



100KC CRYSTAL REFERENCE

## PARTS LIST

| | |
|---|---|
| 1 | *Die-cast box 4-5/8in x 3-5/8in x 2-3/16in.* |
| 1 | *100KC crystal.* |
| 1 | *Bracket to hold crystal.* |
| 1 | *Trimmer 3-30pf (see text).* |
| 2 | *Terminals, 1 red, 1 black.* |
| 1 | *Transistor BF115, SE1001.* |
| 1 | *Transistor OC170, AF116N.* |
| 1 | *10pF NPO or silver mica.* |
| 1 | *47pF plastic or mica.* |
| 1 | *.01uF low voltage.* |
| 1 | *2.7K ¼W resistor.* |
| 1 | *10K ¼W resistor.* |
| 1 | *4.7K ¼W resistor.* |
| 2 | *39K ¼W resistors.* |
| 1 | *Slider switch.* |
| 1 | *9-volt battery No. 216.* |
| 1 | *Bracket for battery.* |
| 1 | *Miniature 8-tag strip.* |
| | *Screws, nuts, hookup wire, solder, etc.* |

* * *

As the success of these investigations became apparent, the writer began to consider the possibility of using a crystal in place of the LC circuit. Work along these lines soon indicated that this idea had distinct possibilities. In particular, it was found to lend itself as a stable 100KC crystal oscillator. More work is being done on other frequencies and it is hoped that we can say more about this at a later date.

Reference to the circuit will show that a complementary NPN-PNP pair of transistors is used, giving fairly high gain. Heavy negative DC feedback makes the circuit very stable from the point of view of thermal considerations as it affects the transistors. Thus, with less components, a greater thermal stability is obtained than by using more conventional methods.

The positive feedback loop has the crystal in series rather than in shunt with it. Series operation has been found to be more satisfactory for 100KC operation. Instead of a high impedance at reasonance across the feedback loop, we have a relatively low impedance in series with the loop. The crystal is actually operated at a point between its series and parallel mode, where its impedance is still low. As such, the crystal acts as a "gate" at the frequency of this low impedance and so permits oscillation at this frequency only.

It will be noted that we have added a simple differentiating network between the oscillator and the output terminals. This improves the harmonic output somewhat.

It is reasonable to suppose that such an oscillator would be capable of very good frequency stability. From a thermal consideration, which is always a problem with valve oscillators, the transistor has a lot to offer, where heat generation can be kept down to a very low level. In common with valve oscillators, careful design and selection of components is still mandatory. In addition, the unit should be constructed in a professional manner.

The unit is built into a die-cast aluminium box measuring 4-5/8in x 3-5/8in x 2-3/16in. This case, which is made by Eddystone, is available through the usual radio parts suppliers.

From the photographs, the general disposition of the major components can be seen. In our particular case, we used an RCA crystal bar. This crystal is mounted in a case which measures 2-1/8in x 1-5/8in x 1-3/16in, with three pins brought out at one end. Some readers may have one of these on hand and it could be mounted in the same way as we have done by making up a "U" bracket of aluminium. Connection to the pins was effected by salvaging some contacts from an old 5-pin valve socket. These contacts slide neatly over the pins to which the leads are soldered.

There are many other suitable crystals which come in various shapes of holders and the methods of fixing it into the box is left to the devices of the builder. Whatever method is used, it is necessary to fix the holder firmly to the box to avoid any random movement such as could occur with some loose fitting sockets.

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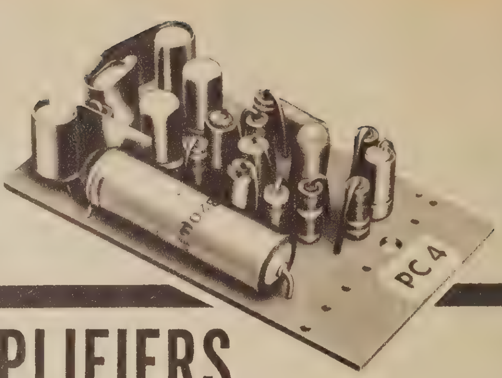

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| Max. ripple voltage | 200 Mv RMS for 150 Ma | 600 Mv RMS for 500 Ma |

## specification details

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|---|---|---|---|---|---|---|---|
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| Input Sensitivity mV | 50 | 1 | 5 | 150 | 5 | 5 | 1V |
| Input Impedance ohms | 1.5K | 1K | 2.5K | 220K | 1.5K | 1.5K | 1M |
| Output Impedance ohms | 40 | 15 | 15 | 15 | 3 | 8 | 600 |
| Supply Voltage-volts | 9 | 9 | 9 | 9 | 12 | 9 | 9 |
| Typical distortion % | 2 | 3 | 3 | 3 | 3 | 3 | 1 |
| Frequency response | 300-15K | 200-12K | 200-12K | 200-12K | 50-12K | 50-12K | 20-20K |
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The trimmer which is connected between the junction of the crystal and the 10pF capacitor and chassis is an NPO ceramic with a capacitance range of 10-120pF. It is mounted on the side of the case with two long screws. Extra nuts are used to stand it off the side of the box by about 3/8in. A hole is drilled so that the trimmer may be adjusted with the lid in position.

Although we have used the trimmer just described, such a large capacitance is not usually necessary. For most crystals, a trimmer with a range of 3-30pF should be sufficient and any good quality trimmer would be satisfactory. Again the mounting of the type which is used must be left to the builder. It would not be wise to use a mica dielectric trimmer as this could result in drift of the crystal frequency.

An 8-tag strip is screwed to the bottom of the box. The rest of the components are fixed to this strip or run from it to other points. This makes for a neat arrangement with short leads. It is most important that all leads and components should be rigidly fixed, otherwise movement can cause frequency shift.

A slider type of "On-Off" switch is mounted on the lid. Fixed also with the same screws, is an aluminium bracket to hold the miniature 9-volt battery in place. Flexible leads are run from the battery to the switch and then to the tag strip. Sufficient length of lead should be allowed so that the lid may be removed for battery replacement and other adjustments.

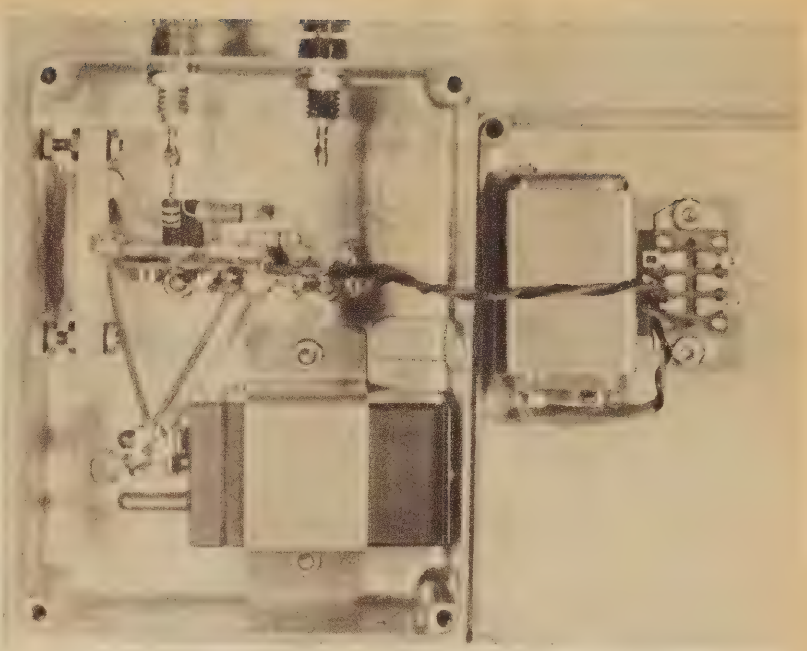
Having finished the unit, the next thing is to check that it does oscillate. If a CRO is available with enough band width in the vertical amplifier, the output of the oscillator may be fed into the CRO and the waveform may be inspected on the screen. This may be done only as a preliminary and is by no means essential.

A short-wave receiver is needed to check the oscillator and to adjust it correctly to frequency. If the receiver is a sensitive one and the checking frequency is around the low megacycles, then it should not be necessary to make metallic contact between the oscillator and the receiver aerial terminal. A short piece of wire, perhaps two or three feet long connected to the oscillator output terminal and draped close to the receiver will give signals of sufficient strength.

The receiver tuning is varied and signals from the oscillator should appear at 100KC intervals. As higher frequencies are tuned, it will more than likely be necessary to connect the wire from the oscillator directly to the aerial terminal on the receiver. If hum should appear on the oscillator signals, the earth terminal on the oscillator should be connected to the earth of the receiver.

So far, we have only proved that the unit is oscillating and that the oscillation harmonics are appearing at approximately 100KC intervals. To set the frequency right on 100KC, perhaps the most convenient method is to tune to one of the WWV(H) frequencies. These are most readily heard on 5, 10 and 15MC, generally in the late afternoon and into the night.

It should be noted that checks should only be made during the periods where no modulation is present. For the first three minutes of each five-minute period, the carrier is modulated with tone. The next two minutes consist of call sign and other information, with silent periods in between. If an attempt is made to check your oscillator during times when tone is present, then it is possible to adjust for a beat against one of the side bands, rather than the carrier so giving an erroneous result.



*This inside photograph shows how we have mounted the 100KC RCA crystal. Other types will need to be mounted differently. Leads should be kept short in the interest of stability. The battery is clamped to the lid, with leads from it to the tag strip.*

Select that frequency of WWV(H) which is being received best at the time and switch on the 100KC oscillator. Adjust the amount of input to the receiver from the oscillator until an easily discernible beat is heard. This beat may be at some very low frequency or it may be as high as 300 cycles or so.

Now adjust the trimmer so that the beat falls in frequency. A condition will more than likely be reached when the beat is audibly lost, having reached the range where the audio response of the receiver is well down. By careful adjustment of the trimmer and listening intently, a "swish" can be heard at a low frequency. Continue to adjust the trimmer until the "swish" slows down and eventually disappears. You have then set your crystal to "zero beat" with WWV.

Having made this adjustment, such an ideal state of affairs is not likely to last. After quite a short time, the swishing is certain to return, indicating that your new pride and joy is not perfect after all. However, assuming that the check has been done at 10MC, and the drift amounts to something like four or five cycles per second, then the order of accuracy of your 100KC crystal reference amounts to a few parts in 10-million. This is better than is normally required in practical amateur work.

It is too much to expect that all crystals will give such a good performance as the one just described, nor is it reasonable to assume that this short term stability figure will be retained over a long term. In spite of all this, such a reference oscillator can be of considerable use for the task of calibrating new receivers and trasmitters, as well as checking the calibrations of existing equipment. The stability of the newly constructed VFO may also be checked, just to mention a few.

Perhaps some readers have been wondering by now, just how accurate frequency drift measurements can be

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E.A., June, 66.

made. Needless to say, in high-level laboratories and national standards institutions, the equipment available for such measurements is very expensive and is capable of many orders of accuracy greater than we are contemplating in this article. For all that, with the aid of a CRO and a good audio generator, it is possible to make comparison checks against a standard such as WWV, to within about two cycles per second at 10MC. If a standard is available at 20 or 25MC, then we can increase our accuracy accordingly.

Let us refer to the block diagram which shows the setup required to make these measurements. The oscillator to be measured is shown at the left and its output is coupled into a receiver. The receiver must be capable of being tuned to the standard frequency of reference, which will also be the fundamental or a harmonic of the oscillator to be measured.

The audio output of the receiver is fed into the vertical amplifier of an oscilloscope. Last in the chain, an audio oscillator which must be well calibrated with a good dial, is fed into the horizontal amplifier of the oscilloscope.

Suppose that we wish to make a check on the stability of our new 100KC crystal oscillator. Here is a suggested method of going about it. No doubt as circumstances dictate, some variations on the general method may be made to suit individual requirements.

We will assume that WWV is to be the standard reference on 10MC and so the 100th harmonic of the 100KC oscillator is to be the subject of the measurement. Set the audio oscillator to say 150 cycles and adjust so that a convenient size of horizontal trace is obtained on the CRO screen.

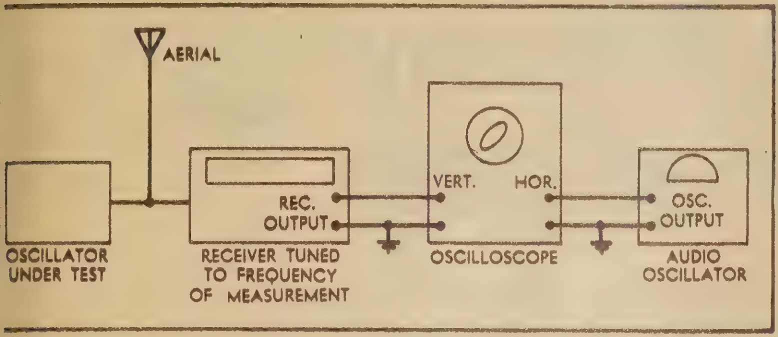
Switch on the 100KC oscillator and provide sufficient coupling from it into the receiver so that a good beat may be heard. Now adjust the trimmer so that the oscillator is shifted off frequency by 150 cycles, either high or low, so that a 1:1 ratio Lissajous figure is obtained on the CRO. It may be easier to change the frequency of the audio oscillator slightly at this stage to get a stationary figure, which will be anything from a 45 degree straight line to a circle according to the actual phase relationship. Whatever pattern is settled for, this should be pursued for the rest of the measurements.

If the audio oscillator has been altered to say 148 cycles, then this must be the reference for all subsequent readings. It is normally convenient to take readings every five minutes during the period when no modulation is present, as mentioned earlier.

Each reading should be recorded after re-setting the audio oscillator when necessary to obtain a stationary figure on the screen. The difference, either positive or negative, between the original reading and each subsequent reading is the measured drift of the oscillator under test. The series of readings would normally be taken over a long enough period such that stability has been reached. When the exercise has been completed, do not forget to re-set the 100KC oscillator back to zero beat with the standard.

This is the fundamental principle of making this type of measurement and it can be applied to the requirements of the individual as he sees fit. However, ne further comments may not be of place, enlarging on what can sonably be expected when this thod is used.

After taking a series of measurents as described above, you may find t the measured drift over, say an ır has only amounted to five cycles so. The obvious question then is, t how accurate are these measurents anyway? This is a very good estion and we will try to answer it honestly as possible.



*This block diagram shows one setup for the reasonably accurate assessment of oscillator drift when compared against a standard of known accuracy. The method of taking measurements is discussed in the text.*

The method is perfectly sound but it es have limitations. Perhaps the two atest factors are built into the partiar audio oscillator which happens to used. How stable is the audio oscilor and how accurately is it possible read off the scale calibrations? These l vary from one instrument to aner and so we can only generalise. t to give some idea as to what may reasonably expected, here is our perience.

First of all, we chose a beat freency of 150 cycles, and this was done a number of reasons. One is, that s frequency will be passed readily most receivers, though possibly with apid fall-off below this point. Another that, at this relatively low frequency, should be possible to read the dial the nearest cycle. However, this is out the limit of accuracy in most ses, introducing our first possible ırce of error, to the extent of about e cycle.

The frequency drift of the audio cillator can be checked quite accurateagainst the 50 cycles of the mains pply. Again using Lissajous figures t with a ratio of 3:1, we checked r oscillator at 150 cycles. From a ld start to warm up over something e one hour, the drift proved to be ee cycles. After this time, the audio cillator could be relied upon to stay thin one cycle of the indicated read. With another one cycle of possible or, the total is now two cycles.

When measurements to this order of curacy are being made, phase shift comes a consideration. Reference to s was made earlier when we mentionthe shape of the Lissajous figure on CRO screen. Errors of setting here n amount to quite an important part a cycle. Again, it can also be ticed that phase shift occurs due to opagation conditions and fading of the ceived standard signal. However, this ect is usually only momentary and es not appear to be significant for the order of accuracy in which we are interested.

So it seems that if we allow three cycles as our margin of error, we should be playing fairly safe.

Having arrived at certain performance figures for our crystal oscillator, it is possible to use it as a sub-standard, against which measurements may be made on oscillators where the expected stability is of a lower order. This can be of particular value under conditions when WWV is not coming through well enough to be used for measurement purposes. Also, checks can be made at any multiple of 100KC, which can be a decided convenience.

As a general rule, self-excited oscillators, which includes variable frequency oscillators, do not exhibit the order of stability to which we have been referring. For such oscillators, the better ones may have drift figures amounting to only tens of cycles at 10MC. On the other hand, figures running into the kilocycle region are quite common.

When measurements are to be made where the amount of drift is likely to be considerable, than the figure initially chosen for the beat frequency on the audio oscillator must be considered accordingly. Needless to say, the accuracy of measurement will deteriorate but this should not be serious.

Among the more obvious uses for a 100KC crystal reference oscillator is the calibration of a new receiver, transmitter, or variable oscillator, as well as checking the dial calibrations on that old receiver.

There is one obstacle which must be overcome in this application. Before any calibration can be done, at least one frequency must be identified with certainty within the range to be covered. In the case of a short-wave receiver, the frequency of one signal must be ascertained.

By way of an example, suppose that we wish to calibrate some range which includes the 6MC band. In Sydney, the ABC maintains a short-wave transmission of their programs on 6090KC. Having identified this, we can switch on the 100KC oscillator and by tuning up 10KC a harmonic will be found on 6100KC. With this identification, it is only necessary to count the 100KC harmonics along the dial and calibrate accordingly. When checking a receiver for existing calibration accuracy, the task will be somewhat easier. ■

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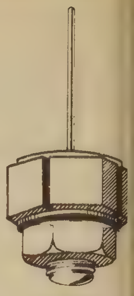
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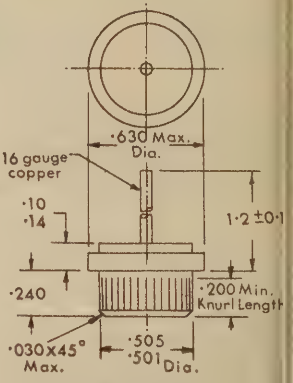

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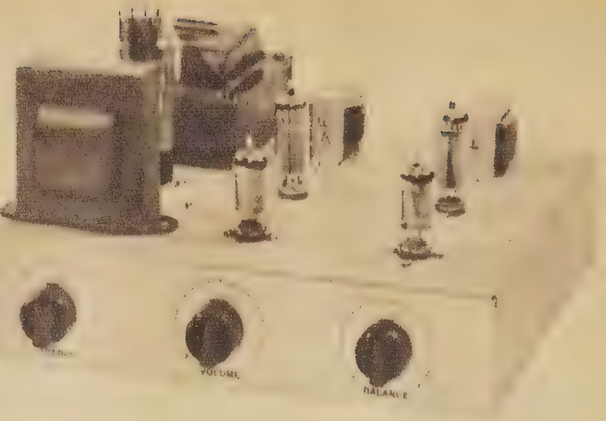
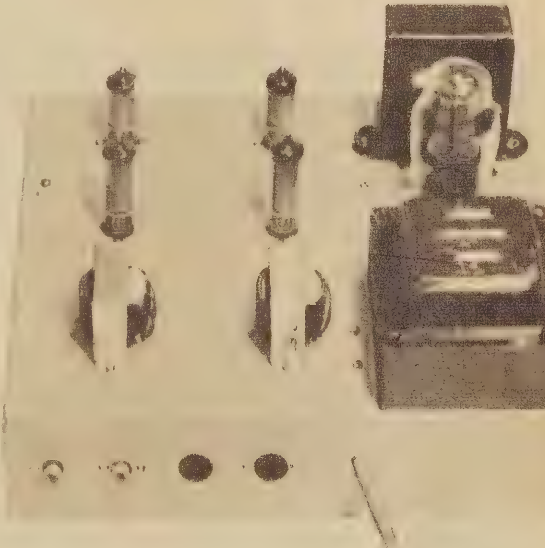


### *By Keith Woodward*

We have described a number of "spare parts" designs in recent issues, aimed at providing our younger readers with practical projects they can undertake with a minimum of outlay, using parts salvaged from old receivers. Here is our latest suggestion; a stereo amplifier suitable for modern pickups and speakers and capable of giving a very good account of itself in any loungeroom.

We have described many stereo amplifiers in the past years, most of which have been built around modern components and on the smallest practical chassis. The chassis presented here is larger than would seem necessary for the components used, but this is deliberate, and allows a wide selection of components to be mounted without space problems. We elected to use 7 pin miniature valves in our prototype amplifier, as these types are now quite readily available from scrapped broadcast receivers. If it is desired to use octal valves, then details of a suitable circuit (March, 1960), may be obtained through the information service.

Our guiding factor in the construction of this amplifier was to produce the wherewithall to enjoy stereo discs with the best frequency response and least possible distortion at a low cost. We feel that there is no need to extol the virtues of stereo reproduction as compared to monaural reproduction, as the effect of perspective from stereo is now fully accepted.



*The photographs above and below clearly show the spare space available on the chassis to accommodate various power and output transformers. We used miniature four-pin sockets for the speaker outlets but these could be replaced with standard sized sockets if available.*

Past experience has shown that, for routine domestic listening, two channels of 3 or 4 watts each is adequate, the full output being very rarely used.

This simplifies the required circuitry appreciably as we need use only two single-ended channels, using two valves, an output stage and a voltage amplifier per channel. Our selection for these were a 6AU6 voltage amplifier and a 6AQ5 output stage.

If valves other than those specified for the output stage are used it will be necessary to check the bias requirements and the output impedance. Our amplifier uses output transformers with a primary impedance of 5000 ohms but this might not be correct if other valves are used. The load impedance for output valves is quoted in all valve manuals and such a manual should be consulted before selecting the output transformer and cathode bias resistor.

Some valve manuals state the size of the bias resistor, others only the grid bias required. In the latter case it is a simple matter to apply Ohms law to find the correct resistance. For instance if a bias of 10 volts is required and the total plate and screen current is 50mA then the resistance would be 10 volts divided by .05A, which equals 200 ohms.

Another variable pertaining to the output transformer is the impedance of the speakers to be used. In our unit we selected 15 ohms, which is a popular standard for high-fidelity units. If other impedances such as 2 ohms or 8 ohms are used the output transformer secondary must be similarly rated. This will also effect the negative feedback, which will be discussed later.

The circuit is simple and non-critical. The voltage amplifier operates with a gain of about 200, which figure is reduced by the application of feedback. The net result is an input sensitivity suitable for current stereo crystal pickups.

The power supply is quite straightforward. A 285-volt per side, 100mA power transformer supplies the necessary voltages. The 100mA rating is just adequate for the amplifier, and those wishing to provide for a tuner as well will need a 125mA transformer.

Almost any existing transformer could be pressed into service, there being adequate space on the chassis for all but the largest types. Our transformer had two 6.3 volt heater windings, one centre-tapped. The centre-tapped winding was used for the 6AU6 valves, the centre-tap being returned to chassis. This configuration helps minimise hum problems. The other winding was used to supply the 6AQ5 valves, one side being returned to chassis.

If only one 6.3 volt winding is available it is suggested that it be run in twisted leads to all valve heaters and a 100 ohm slider resistor be connected across the winding. The slider arm is returned to chassis and set to give minimum hum in the amplifier. This will be approximately in the centre of the resistor.

Although a HT secondary voltage of

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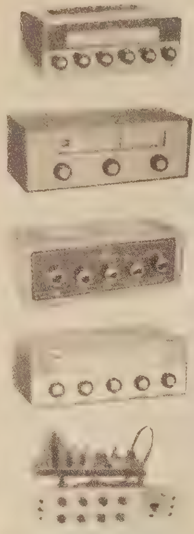

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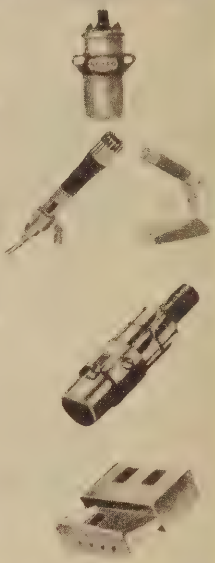

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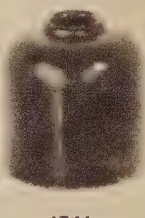
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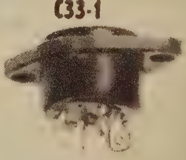

C33-2

C33-7

C33-6

C33-5

C-33-3

285 has been specified as optimum, there is no reason why transformers having lower or higher voltages cannot be used. Lower voltages will result in lower HT and reduced power output, as explained elsewhere, but performance should still be adequate. Higher voltage transformers will need suitable values of dropping resistor in the dotted position shown in the circuit, the value always being selected to keep the HT supply within the limits imposed by the chosen output valves.

The filter choke may be any type which will fit on the chassis and having a current rating of 100mA or higher. The one used in the prototype is actually a 6 henry choke stripped from an old chassis. The type used will have some bearing on the final HT voltage by reason of its DC resistance.

When using 6AQ5 valves in the output stages the high tension voltage, measured at the 50uF electrolytic capacitor, should not exceed 260 volts. Several factors will influence this figure, apart from the transformer secondary voltage; the efficiency of the rectifier valve, the DC resistance of the filter choke, and the size of the electrolytic capacitors.

The rectifier we used is a 5V4, mainly because it happened to be on hand, and this type is somewhat more efficient than other types and gave somewhat over the 260 volt figure. There are several rectifier valves suitable for our circuit, some of these being: 5Y3G, 5AR4, 5AS4, 5U4G, 5X4G and 80.

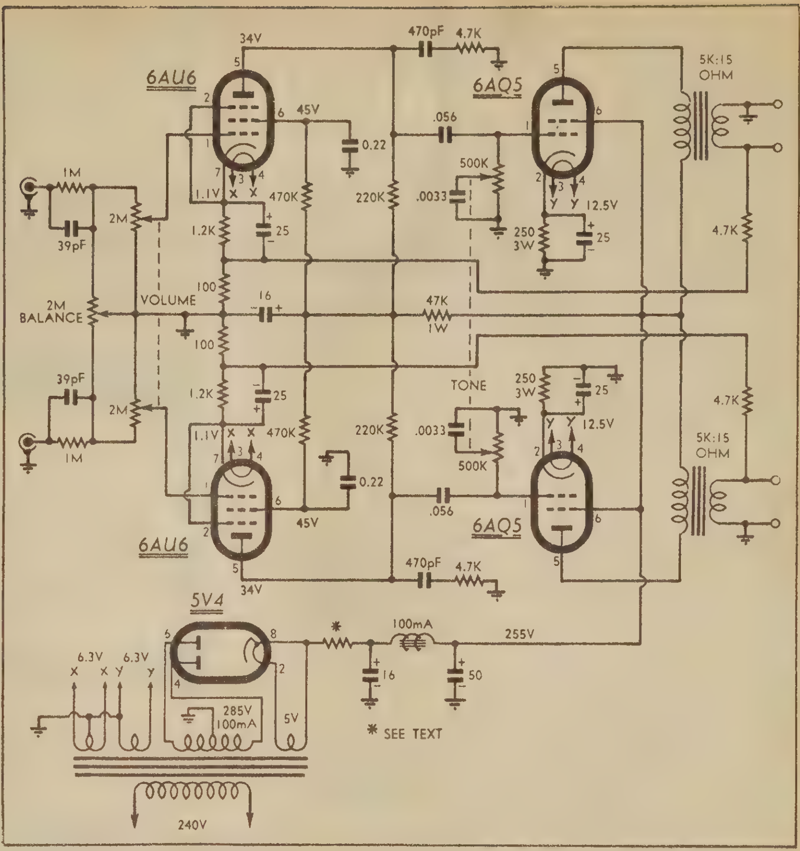
If a combination of factors results in the high tension supply exceeding 260 volts this may be decreased by the insertion of a suitable resistor in the point shown dotted on our circuit diagram. In our case a 120 ohm, 15 watt resistor resulted in a final voltage of 255 volts, a drop of 55 volts over the figure without this resistor. While it is dangerous to exceed the figure of 260 volts no harm will be done if the high tension is on the low side, even to 200 volts. This will reduce the available output but this should still be quite sufficient for the normal living-room.

There are three electrolytic filter capacitors in the power supply circuit. Do not in any circumstances use electrolytics salvaged from an old receiver. Their capacitance will be low and their leakage may have deteriorated sufficiently to endanger the rectifier and perhaps the power transformer. New electrolytics are really essential.

Negative feedback from the voice coil to the pre-amplifier cathode is used in this amplifier. About 15dB is used, being a safe enough figure for most of the cheaper output transformers. The feedback resistor specified is for a 15 ohm voice coil. If it is desired to use a speaker with a 2 ohm coil then the transformer must be purchased to suit and the feedback resistor should be reduced from 4.7K to about 1.8K. For 8 ohms, 3.3K would be about right.

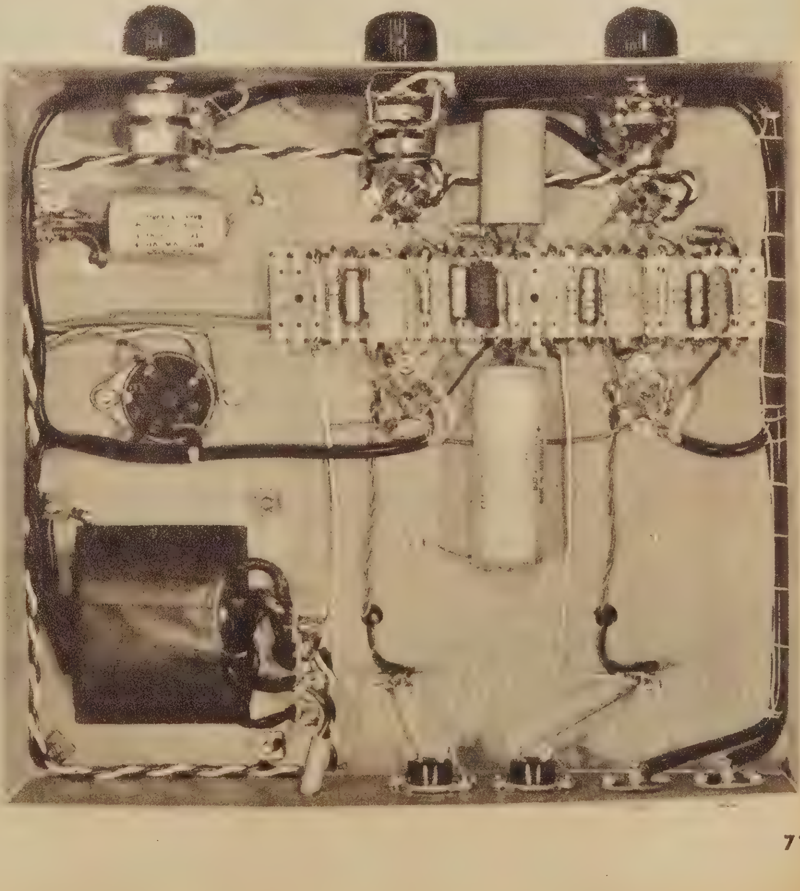
The polarity of the feedback must be established by trial and error. If the feedback is positive, it will increase the gain of the amplifier and usually cause it to oscillate at an audible frequency. To correct this, reverse the primary or the secondary leads of the output transformer, not both. When the feedback polarity is correct there will be a noticeable reduction in gain of the amplifier.

A certain amount of ringing would normally be present in any amplifier in which the output transformer is included



*The 4.7K feedback resistor shown in the circuit above is correct for 15-ohm speaker systems. For other impedances this value will have to be varied.*

*The tagstrip shown in the underneath view was pre-wired before securing on the chassis.*



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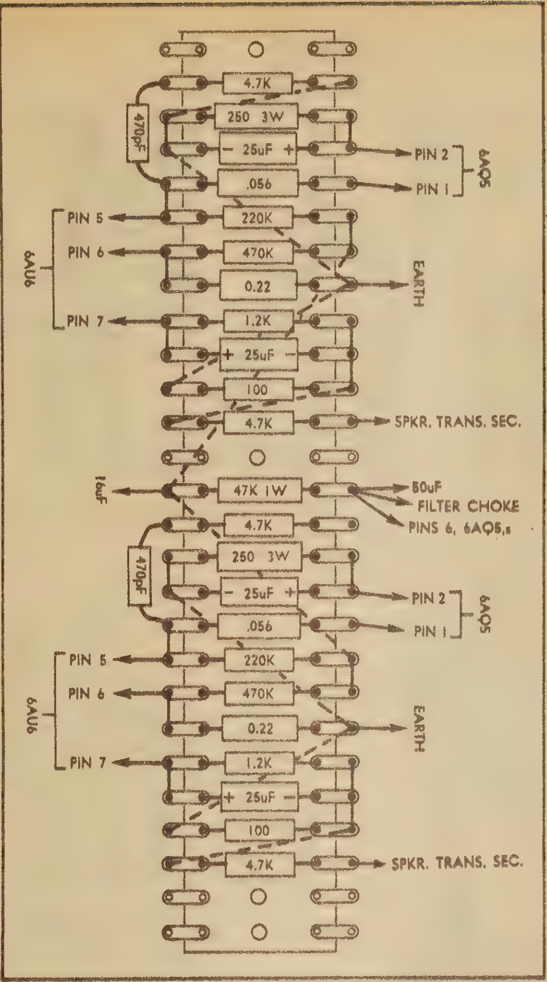

*In the detailed diagram of the tagstrip shown above the dotted lines indicate wiring underneath the tagstrip.*

the feedback loop. nging is a tendency to cillate at one or more quencies when a sharp rst of sound at this quency is applied to input of the ampli- r. The amount of ring- is closely associated th the output trans- mer used and could be mpensated for with a pacitor across the feed- ck resistor. However, s method of compen- ion requires the use of t equipment to allow selection of suitable pacitance value.

Another method of hieving the same result to use a "step" circuit the plate of the pre- nplifier valve. The lues used at this point not so critical as in previous method and ay be wired into the cuit without consider- on of the output trans- rmer to be used. The p circuit shown was ed in our own ampli- r and gave completely isfactory results.

The output transform- used in our amplifier re deliberately chosen being representative of low-cost types likely be used in a project this kind, and they oduced quite heavy ging without the step cuit. They may be re- rded as typical of what likely to be used.

However, these re- arks apply to output nsformers designed d built as such, rather an the nondescript peaker" transformers ich might be salvaged from old eakers. Even if these have the correct pedance ratios it is extremely unlikely at they would perform satisfactorily a voice coil feedback circuit—at least, t at this level of feedback.

The step circuit does introduce some s in the treble response, but this can offset by providing some deliberate ble boost outside the feedback loop. this case, a 39pF capacitor is con- cted in parallel with each of the 1M istors in series with the input circuit. the frequency rises, the impedance of se capacitors decreases, providing a nificant degree of treble boost.

All modern disc recordings are made cording to an agreed standard record- characteristic, aimed at improving recording quality and increasing the ying time, but requiring the playback uipment to have suitable complement- characteristic.

More precisely, the record is made th a deliberately attenuated bass re- nse, and a deliberately boosted treble ponse. In playback, therefore, we have boost the bass response and attenuate treble, in order to restore the lance.

Fortunately the simpler type pickups, stal and ceramic, for which this ampli- r is intended, provide a suitable degree bass boost as a natural characteristic, ving only the treble attenuation to be provided by the amplifier. This can be provided quite conveniently by a simple continuously variable top cut control which can be adjusted by the user for best results.

Balance between the channels is achieved by means of a 2M linear potentiometer in the input circuit. It provides adequate control to achieve equal output from the channels.

High output pickups may be used without worry as the volume control is directly in the input circuit, making it impossible to overload the first stage before the output valve is itself overloaded.

No doubt many will have speakers on hand which they wish to use. However, if new ones are to be purchased, we would suggest the 6in low cone resonance types, as used in our Playmaster Bookshelf system. If these are suitably baffled for initial use, they can then be used at a later date to make up two com-

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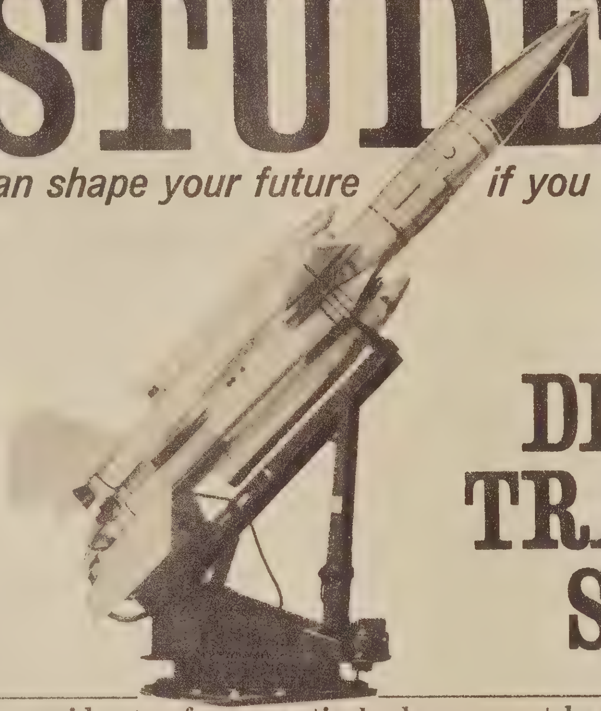

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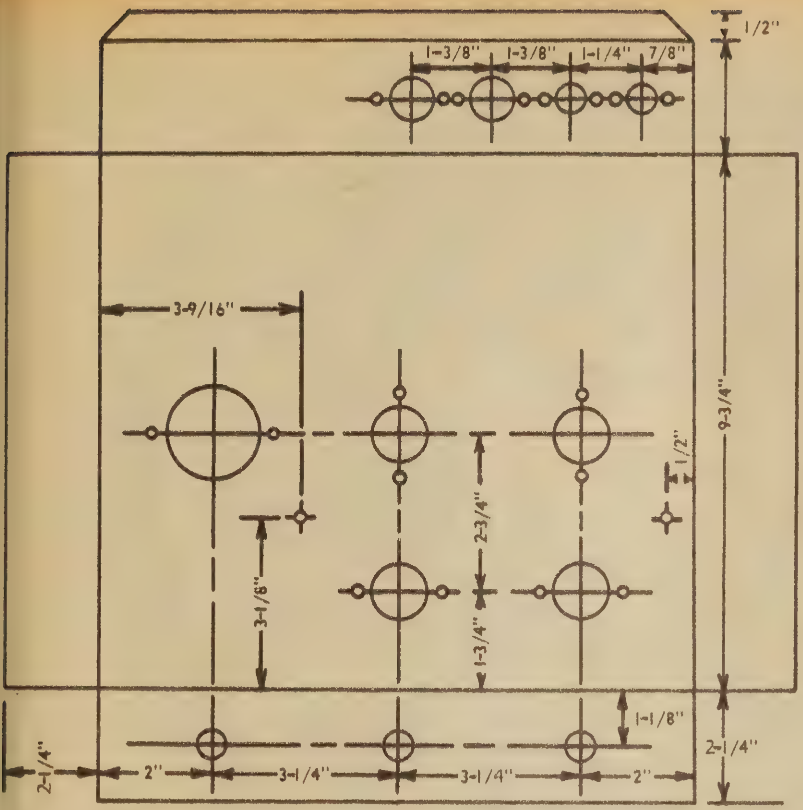

*A partial diagram of the chassis is given above. The valve socket centres are spaced so that either miniature or octal sockets may be used without fouling the pre-wired tagstrip.*

plete bookshelf systems when the finance is available.

The layout is essentially simple and the various components fall into logical sequence. A study of the accompanying photographs should assist those planning to use a different chassis, as well as those adhering to our layout. For the latter we have included a partial sketch of the suggested chassis.

The valve holders have been placed and orientated in such a manner that a minimum of wiring is used between the valve sockets and the tagstrip. The use of the tagstrip allows the majority of the components to be prewired before securing it to the chassis. A wiring diagram for this tagstrip accompanies this article.

It will be noticed that the tagstrip, other than the central resistor, is virtually duplicated and a good check before installing it is to check one half against the other for wiring discrepancies.

## SPECIFICATIONS

*Power output: 4.2W per channel, RMS, measured at output transformer primary.*

*Sensitivity: Input signal for maximum. undistorted power output, 600-mV.*

*Frequency response: 35cps to 20KC plus or minus 3dB.*

*Frequency compensation: Continuously variable top-cut control.*

*Feedback: 15dB, from speaker voice coil.*

*(The above figures were taken from our prototype, and will serve as a guide to likely performance. Naturally, some variation may occur with circuit and component changes.)*

The voice coil output is taken to two four-pin miniature sockets on the rear edge of the chassis via a two tagstrip. The two tagstrip allows the secondary of the output transformer to be reversed for correctly phasing the feedback polarity.

We were quite happy with the results obtained from our prototype amplifier as an undistorted power of over four watts was available at each output transformer primary at a test frequency of 1KC. The frequency response extends from 35cps to above 20KC with a maximum deviation of 3dB.

Maximum undistorted output from our amplifier was developed with an input to the pickup terminals of 600mV. As full output will rarely be required pickups with a marginally lower output than this figure should produce sufficient output power for most requirements.

As a final test, we fed the amplifier into a pair of Playmaster Bookshelf speaker systems and used a ceramic cartridge pickup into the input. The listening quality was excellent and more than sufficient output was available for the normal domestic living-room.

With such a simple circuit there is only one improvement which would prove worthwhile, that is the use of high-quality output transformers. This would improve the frequency response level and provide a small improvement in output power. However, even with the cheaper output transformers, the amplifier makes a simple project for the beginner and an economical stereo outfit for the audio enthusiast. ▭

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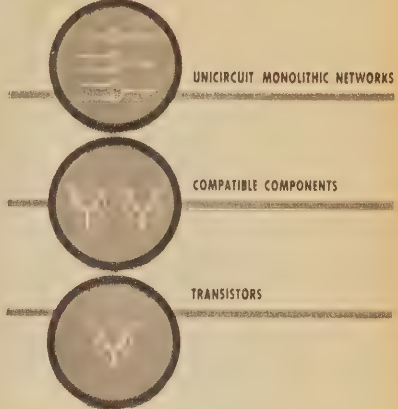

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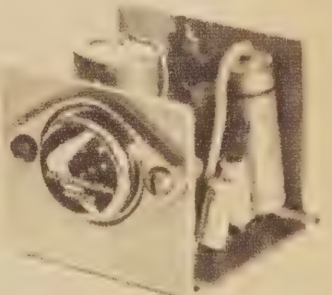

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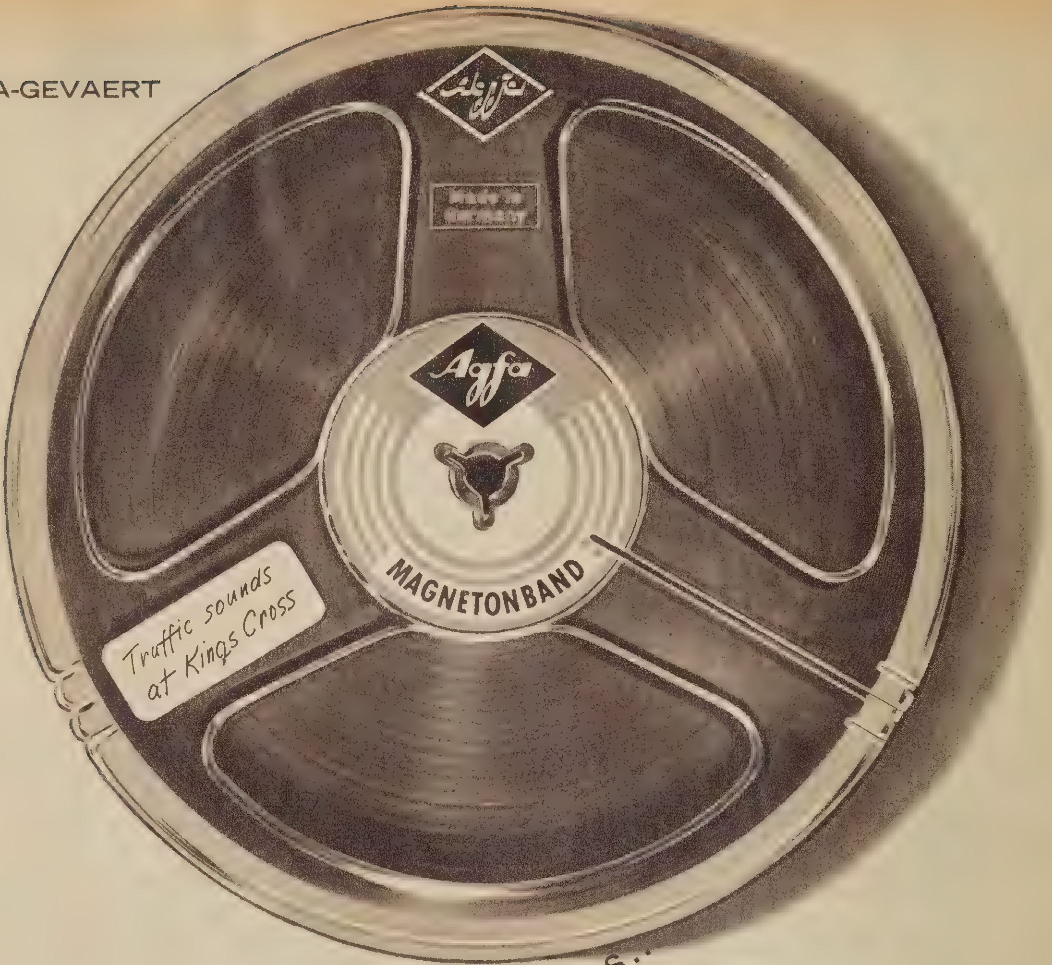

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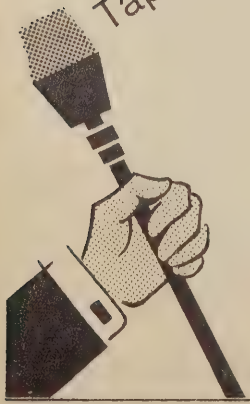

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# Tuning Fork Frequency Control

In many precise frequency control applications a tuning fork is just as useful as, and a lot more convenient than, a quartz crystal. This article, taken from "International Electronics," is an excellent account of the modern tuning fork; its accuracy, and its place in precision equipment for science, industry, and the armed forces.

### By Frank Dostal *

A tuning fork has been described as one piece of metal with two moving parts.

The tuning fork was invented in 1711 by an English trumpet player, John Shore, who used it to check the musical pitch of his primitive trumpet. The composer, Handel—for whom Shore worked, or rather played — thereupon became satisfied with the tonality of the trumpet and made extensive use of that instrument in later works. Since this was a frequency control application, it can be truly said that the fork is one of the oldest vibrating devices still in current use for frequency control.

Soon, in crude form, forks were used as time bases in physics experiments by such giants as Helmholtz, Lissajou, Lord Rayleigh and others. By 1878, Edison put the fork to work in a multiplex telegraph system. Since then, forks have been used in a multitude of devices such as precision clocks, watch-rate equipment, reference clocks in computers, facsimile equipment, power line regulation, navigation systems, tape recorders, satellite timer, guidance systems, star trackers, spectrophotometers and geophysical instruments. A unique use of a fork is in the Bulova Accutron electron timepiece, where the fork replaces the balance wheel.

The early uses of forks were restricted because there were no methods of keeping the fork vibrating. Helmholtz worked out a technique using a contact and coil arrangement which was satisfactory in the laboratory, but not practical for general usage. Edison devised a simple buzzer system to maintain the vibrations. An improvement on this, using a carbon microphone button which actuated a driving coil, soon followed.

Ideally, the pickup and drive device for maintaining vibrations should be loosely coupled to the fork. In present day practice, this is accomplished by using a magnetic transducer for both the pickup and drive functions.

This transducer consists of a magnet inside a coil located close to the tine. Changes in flux, due to the vibration, produce a signal in the pickup. Conversely, a signal applied to another transducer, also located near a tine, will maintain motion. An adequate amplifier connected between the two will cause the fork to vibrate at resonate frequency (figure 1). Typical gains required in the amplifier are 10 to 50dB, depending on the fork design.

Forks begin to oscillate when power is applied due to noise in the circuit and will reach 90 per cent of full amplitude in about Q oscillations.

*Physicist Max Hetzel, of Bulova's Switzerland plant, compares an ordinary tuning fork with the minature one used in the Bulova electronic watch.*

The frequency of a fork varies slightly with amplitude, due primarily to the small contribution of the field of the magnets to the fork stiffness. Therefore, for high precision, the driving power is held constant by such means as zener diodes, negative feedback or AGC (figure 2). For looser tolerances a simple amplifier is adequate.

Other fork drive methods used at various times are electro-static, magnetostrictive, pneumatic, piezo-electric and most efficient of all, the electro-dynamic.

The electro-dynamic drive, a refinement of the magnetic transducer mentioned in connection with figures 1 and 2, is very efficient, due to the very good coupling between the circuit and the tine motion. In this method the coils are stationary and the magnet system moves (figure 3). In the Accutron timepiece, the use of this type of drive brings the power requirements down to 6 microwatts, sufficiently minute to provide more than one year's operation from a small internal battery. Incidentally, this is one of the largest single applications of the tuning fork.

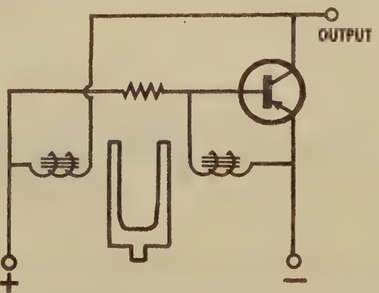

*Figure 1. Basic circuit for simple transistor amplifier suitable for maintaining fork oscillation.*

Forks are generally available in frequencies from 60cps to about 8000cps. However, American Time Products offers forks in frequencies from 40cps to 25,000cps, believed to be the widest range available.

The frequency of a fork is determined by the tine dimensions (figure 4). Frequency is directly proportional to the tine thickness and inversely proportional as the square of the length. The remaining dimension (h) has no relation to frequency, except when the tines are loaded with weights for low frequency applications. Usually, a low frequency fork is long and a high frequency one is short. However, this is not absolute. A 1,000cps fork could be made 20 inches long, and a 40cps one only one inch long, if there was a pressing need.

Normally, forks are driven so that they vibrate in a fundamental mode. However, higher frequencies are often produced by driving a fork in an overtone mode (Figure 5). This produces frequencies approximately six times the fundamental mode. In this case, we have one piece of metal with four moving parts. A fork generating 25KC in this mode is less than an inch long. Higher modes are not practical at the present time.

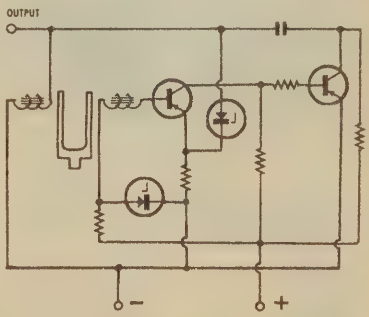

*Figure 2. A more refined amplifier using zener diodes to maintain constant driving power, essential for high precision.*

The Q of a fork depends on its material, dimensions, and the method of driving the fork. Forks made of certain aluminium alloys can attain about twice the Q of nickel alloy forks but have very poor frequency vs. temperature coefficients. Elinvar and Ni-Span C.

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*American Time Products Bulova Watch Co., Inc., Woodside, N.Y., U.S.A.

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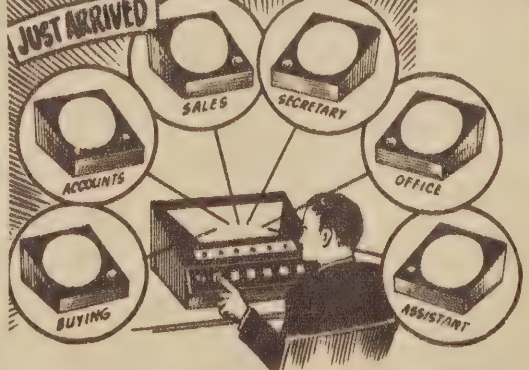

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orks attain Q's as high as 25,000 in acuum when driven electrostatically. owever, in practice, due to damping aused by the pickup and drive magnets, he Q of a fork is normally about 5000. This turns out to be high enough for tability, and low enough to afford up o 200 parts per million of trimming vith a phase control.

For a plain steel fork, the change in requency due to change in temperature mounts to about 100 parts per million er degree C. A 1,000cps steel fork, for xample, will vary 5cps for a 50°C hange.

To help alleviate the effect of tem- erature on frequency, use is made of he alloy Elinvar, developed in France bout 1910. This improves the tempera- ure coefficient by over 100 times.

Today, other alloys such as Ni-Span , Vibralloy and Nivarox are also used o produce low coefficients. These alloys re heat-treated to adjust the co-efficient. owever, for close coefficients over wide emperature ranges, the heat treating pro- ess is not consistent enough to allow the se of alloy forks for general applica- ons.

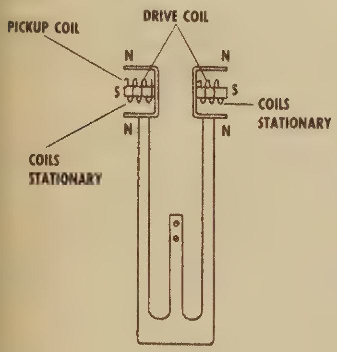

*Figure 3. The principle of dynamic drive, as used in the electronic watch. Photo, page 77.*

One of the most practical methods f compensation used today is Eisen- our's bimetallic fork. This is made of laminate of a positive coefficient linvar alloy and a negative coefficient eel alloy. The coefficient can then be djusted by grinding one laminate or the ther. Changing the thickness of the linvar by .001in changes the coefficient y approximately 1 part in a million per egree C. This change in dimension has nly a slight effect on frequency. A pical temperature-frequency curve igure 6) has a shallow dish shape.

A clever method developed by Russ- r in 1946 for temperature control con- sts of a thermostatic strip at the end each tine. Changes of temperature use the strips to move weights attached the strip, thus changing the effective ngth and frequency to compensate r the temperature change. An early rsion of this was shown by Whitehorn 1927.

One of the ways to lick the tempera- re problem is to use an oven. In the rly Watchmasters (a machine for ecking watches), the fork was enclosed a proportional oven, controlled elec- onically by valves. This oven, in turn, as placed in a coarser oven. Total lume was 2 cubic feet. The system rked, but required eight hours to stabi- e. Subsequent adoption of the two- ement fork resulted in an overall vol- ne reduction of a 1000 to 1 and a cost saving of more than 10 to 1. Approximately 30,000 forks of this type are in use in Watchmaster machines all over the world.

At the present time, temperature vs. frequency tolerances of ±.02 per cent in the MIL temperature range and ±.001 per cent in the room temperature range are readily achieved. Closer tolerances are possible at increasing cost.

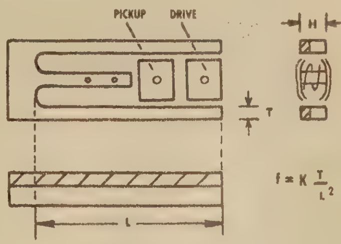

*Figure 4. The vital dimensions of a tuning fork and the formula which uses them to determine frequency.*

A source of error which only occasionally is important is the change in the frequency of a fork due to a change in attitude.

On earth, a fork with tines down finds gravity aiding as a restoring force, and so the fork runs faster than a fork with tines up.

The magnitude of the error due to moving the fork from horizontal to vertical is a number which varies inversely as the frequency in KC squared.

$$\left(\text{Error} = \frac{K}{l\,f^2}\right)$$

Typically, a 100cps fork 3 inches long has an eror of 185ppm while a 1,000cps fork of equal length has an error of only 1.85ppm. So actually, attitude is not apt to be a problem in most applications.

If rotation in only one plane is expected, mounting the fork so that it rotates around its axis only will avoid error. If rotation in all planes is expected, the use of a higher frequency fork with division to the desired frequency will reduce the attitude error to any required amount.

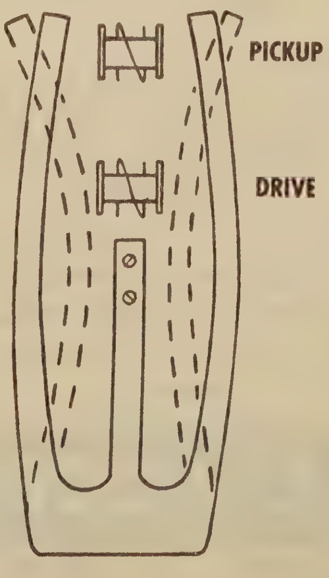

*Figure 5. Overtone operation of a fork. This provides output approximately equal to six times the fundamental frequency.*

Military, commercial, and space applications frequently expose forks to shock and vibration. Of all instruments, forks (and reeds) are, by nature, most susceptible to these factors.

Under vibration or shock, both tines may be caused to vibrate parasitically in phase, in addition to the normal out-of-phase vibration. However, by placing the coils between the tines (figure 4), the pick-up coil will tend to cancel pickup voltage due to in-phase tine motions, and thus reduce this component in the output. A further benefit is that both tines are driven, compared to the orthodox drive applied to only one tine.

Another breakthrough in this direction has been the use of the internal stud mounting of the fork, rather than the usual external stud (figure 7). The intent here is to mount the fork at its centre of moment. This reduces the effects of shock and vibration by approximately five times. Also, the fork is reduced in length, thus saving space. Typically, a 400cps fork of this type can operate with a minimum disturbance in its output during shocks of 100Gs and can survive a 2,000G shock.

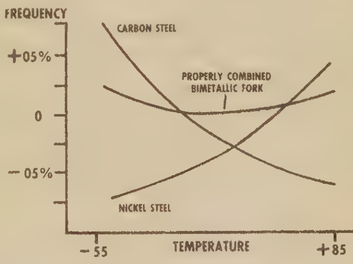

*Figure 6. The effect of temperature on frequency for various materials.*

Additional isolation is normally accomplished by using damped springs and plastic foam materials. In severe vibration problems, a substantial aid is to increase purposely the fork's amplitude of vibration, thus producing a better signal-to-noise ratio. The tradeoff is a slight lowering of stability. Higher frequency forks are much more immune to vibration; a 3KC fork will produce negligible noise under a 20G, 500cps MIL test.

Just as quartz crystals go through an aging process, so do forks. The normal trend, as in a crystal, is to go in a fast direction. The aging on a raw fork is rapid at first and becomes asymptotic in three months' to a year's time. Soaking fork assemblies at moderately high and low temperatures provides a quick "aging" process so that with appropriate subsequent "shelf aging," a unit results which is compatible with its end use.

Forks on life tests for over 15 years verify that aging is asymptotic. These tests also indicate the long useful life of a fork. Complete packages with an MTBF (minimum time before failure) of 200,000 hours for 90 per cent of the units have been delivered.

In instances where precise adjustments are required, the frequency can be ad-

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| Supply Voltage (Nominal) | 9V | 9V | 9V | 9V | 12V | 9V |
| Total Distortion (Full output) | 6% | 6% | 6% | 6% | 3% | 3% |
| Frequency Response | 330 c/s —15Kc/s | 200 c/s —12Kc/s | 200 c/s —12Kc/s | 200 c/s —12Kc/s | 50 c/s —15Kc/s | 50 c/s —15Kc |
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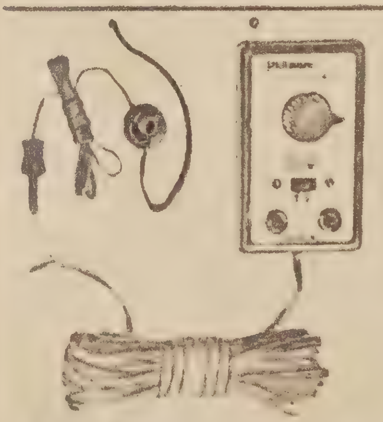

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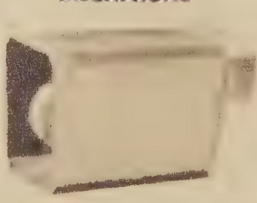

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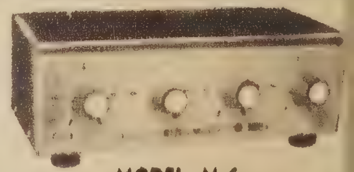
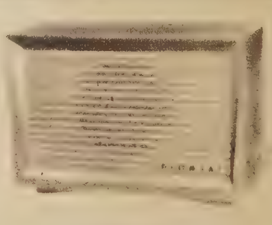


## MODEL M-6

Monaural Microphone Mixer

***Price $6.75***



## MODEL SB-401 PLASTIC CABINET

Complete with 4in speaker.

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# GENERAL ACCESSORIES

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justed with a phase control. Variations up to 200ppm are practical. This is more than adequate to compensate for future aging.

The advent of World War II brought a demand for accurate low frequency time bases for airborne navigational and bombsight systems. The requirements were to survive and operate accurately and be small and light.

The choice of the designer resolved itself to using crystals followed by frequency dividers or forks producing the required frequency directly. The crystal systems required five or more valves, usually in multi-vibrator circuits which were not fail safe — that is, if the crystal circuit or one of the multi-vibrator circuits failed, a wrong output frequency was produced. The fork system was small, light, reliable and fail safe. A large number of radar bombsights used American Time forks which were redesigned in volume and weight by a factor of 10 in a matter of weeks. Large quantities of similar equipment were delivered during the Korean conflict.

The choice between crystal and fork oscillator still faces the design engineer, and the advantage of fork over crystal in such a situation still is a basic fact.

A typical fork in World War II measured 1½in in diameter by 3in long and weighed 8oz. Today, the same performance can often be supplied in a package only ⅜in by ¾in by 1½in long, weighing only about ½oz.

With the advent of microcircuits, there is a need for further reduction in size of other components, including forks. Since 1940, the size has been reduced by a factor of 100. A further similar decrease may be impossible, in fact not justified, but decreases are on the way.

In the past two years, American Time has developed the fork as a modulator of light and energy beams for use in electro-optical systems (figure 8). By attaching vanes to the tines, a light chopper is produced. Putting diagonal slits in the vanes produces a scan action. Optical elements such as mirrors, filters, lenses and others can be mounted on one or both tines for various purposes. Virtually the whole spectrum of wave and particle energy can be handled.

The optical chopper is now being used to vibrate light filters as the basis of a $CO_2$ indicator in space capsules and submarines. Choppers are also being planned as part of the celestial navigation system in the Apollo mission.

Another fork device used in optical systems is the torsional optical scanner. In a torsional fork, the two tines are caused to twist about their own axis in opposite phase. A feature of the torsional fork is the absence of attitude error. This fork is used to cause a light beam, or other energy beam, to scan back and forth. Here again, the light weight, long life, low power features offer benefits to optical designers.

In considering the use of a fork or fork oscillator in a particular application, the engineer must review a number of requirements. The relative importance of one over the other depends upon the particular circumstances.

- Where the required frequency is 25KC or lower, a fork is a good choice. In this range, a fork is generally more rugged than a crystal. The fork is rigidly mounted, components are few and mostly not critical, and aging can be forecast. Reliability of 90 per cent for 200,000 hours is not uncommon.

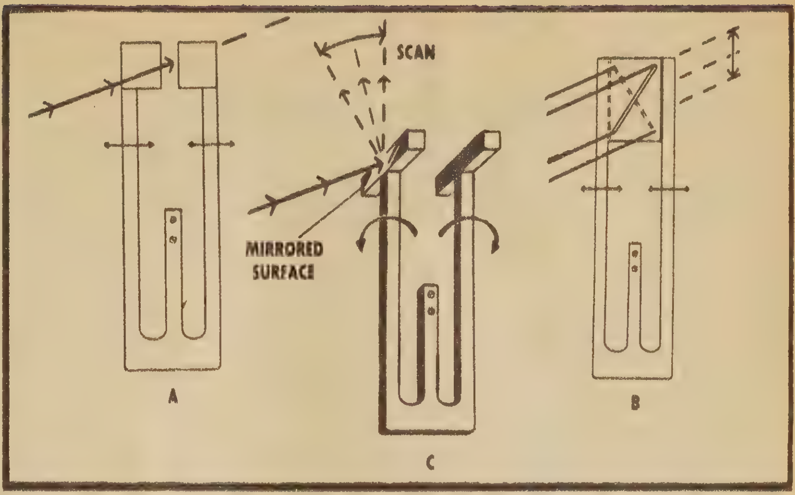

*Figure 8. Some new and unusual fork applications include use as a light chopper (A), by attaching vanes to the fork's tines. Diagonal slits in the vanes (B) produce a scan action. Causing the two lines to twist about their axis in opposite phase (C) produces an optical scanner without attitude error.*

- If the stability requirement is ±.001 per cent or less, a tuning fork may be simpler and cheaper.

- Where size is important, a fork oscillator supplying an audio frequency is smaller than a crystal with divider circuitry. A fork oscillator can be supplied in a package about 7/10 of a cubic inch.

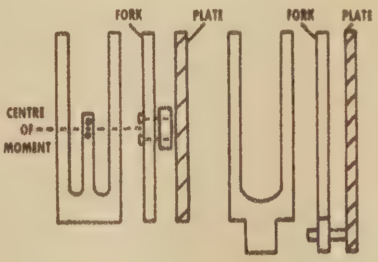

*Figure 7. Illustrating the internal stud mounting principle, and the resultant saving in space.*

- Where weight is important, the same factors apply as in size. A fork oscillator can weigh as little as 1oz.

- As to cost, a fork oscillator is cheaper than a crystal with frequency division. In fact, in the ±.1 per cent to ±.5 per cent stability range, the prices are competitive with LC and RC packages which do not have as good long-term stability as fork units.

- Forks can withstand operating temperature ranges that preclude the use of other devices. American Time has built forks to operate at temperatures of 300°C on the B-70 program and to operate at 200°C two miles deep in the earth for oil well instrumentation. ■

("International Electronics," Mar. 1966)

### EDITORIAL NOTE

Textbooks quote Elinvar as having been developed to provide a low temperature coefficient of elasticity, as required in the hair springs of chronometers and high grade watches. No mention is made of its temperature coefficient of expansion. It consists of: 36 per cent nickel, 12 per cent chromium, 1.5 per cent silicon, 0.8 per cent carbon, and 49.7 per cent iron. (The word "Elinvar" is a contraction of "ELasticity" and "INVARiable.")

Invar is another alloy frequently mentioned as being used for tuning forks. It was developed for use as a standard of length which would be immune to temperature changes and can be made with virtually zero coefficient of expansion (or even negative in some cases.) It is used, among other things, for pendulum rods in high grade electric clocks. ("Invar" is a contraction of "INVARiable.")

Both Invar and Elinvar were developed around 1910 by Dr C. E. Guillaume, co-director of the Bureau Internationale des Poids et Measures, France.

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# The Serviceman

## ON FEEDBACK, PHASE, AND SUCH

The current popularity of audio amplifying systems and, in particular, the "do-it-yourself" kits for the not so experienced home builder, has produced a new type of customer for the serviceman: the enthusiast who, having "followed all the instructions," still finds himself in strife when he switches on.

Usually, such troubles are relatively minor, since most kits use well proven circuit designs and top quality components. Occasionally one will strike a faulty new component which "throws" the beginner but, more usually, straight out simple wiring mistakes are the cause of the bother.

But, as this story will demonstrate, a very simple mistake can produce the most disconcerting symptoms.

In this case our home builder had tried to build himself a moderately complex stereo amplifier. The circuit was quite straightforward, employing two 6GW8s in each channel, with the pentode sections as push-pull output stages, and the two triode sections as amplifier and phase inverter respectively in each channel. There was also a twin triode, with each half as a pre-amplifier feeding a frequency compensation network. However, this section was not involved in the trouble.

The customer's complaint was severe lack of balance between the two channels, plus an effect which he described as, "a slow swishing sound." He added, by way of background, that the balance problem, although still serious, was a good deal better than when he had first built it.

He went on to explain that he had achieved the present order of performanc by, "fiddling around with resistors in the feedback circuit." This latter remark prompted me to ask whether he was sure that he had the feedback correctly phased in each channel. Previous experience has taught me that incorrect feedback connections constitute a significant proportion of the troubles encountered by the less experienced home builders.

One reason for this, incidentally, is a rather elementary one. To a good many experimenters the idea of deliberately doing anything which will reduce the gain of a system is so foreign to their pre-conceived ideas as to be almost sacrilegious. Often, they are old timers who have come back into the game after many years, and who remember the simple equipment of a bygone age in which sensitivity was the all-important factor.

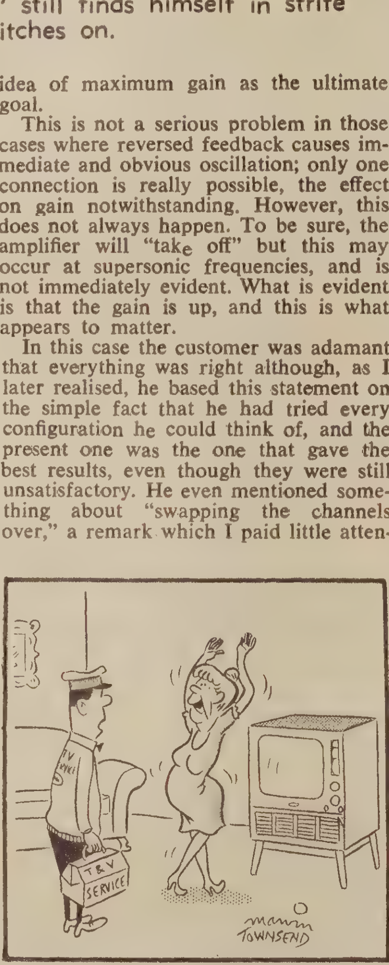
Thus, when faced with the need to make an experimental connection in a feedback circuit, and not being too sure exactly what this part of the circuit is supposed to do, or what effect they are seeking, they are pre-conditioned to the idea of maximum gain as the ultimate goal.

This is not a serious problem in those cases where reversed feedback causes immediate and obvious oscillation; only one connection is really possible, the effect on gain notwithstanding. However, this does not always happen. To be sure, the amplifier will "take off" but this may occur at supersonic frequencies, and is not immediately evident. What is evident is that the gain is up, and this is what appears to matter.

In this case the customer was adamant that everything was right although, as I later realised, he based this statement on the simple fact that he had tried every configuration he could think of, and the present one was the one that gave the best results, even though they were still unsatisfactory. He even mentioned something about "swapping the channels over," a remark which I paid little attention to at the time but which assumed some significance as I delved into the problem.

On the bench, the complaints appeared to be confirmed. There was no doubt that the gain of one channel was much higher than the other, while the "slow swishing sound" turned out to be a remarkably accurate layman's description for an unusually low frequency "motorboat."

This was barely audible under no signal conditions, and then only with one's ear close to the speaker. The "swish" was, in fact, simply the normal noise level of the amplifier varying in amplitude at about eight or ten cycles. With a 1,000cps tone fed through the amplifier, and displayed on the C.R.O., it showed as a moderate amplitude variation, looking very like the classic "modulated envelope" diagram found in text books.



"— then at other times the picture looks like this." ("PF Reporter")

This in itself was sufficiently unusual to attract my attention, since the usual effect of motor-boating is simply to shift the pattern bodily up and down on the screen. I also noted that the effect in the loudspeaker was much more obvious with a signal present.

By this time, and despite the owner's assurances—or perhaps because of them —I had a strong suspicion that the trouble was somewhere in the feedback system. Fortunately, he had supplied the circuit which came with the kit, and I took a closer look at the feedback circuit.

It was the conventional arrangement. Signals were picked up from the output transformer secondary and fed into the cathode circuit of the amplifier stage, at the "top" of a 100 ohm resistor inserted between the normal cathode bias network and chassis. The feedback line consisted of a 4700 ohm resistor, bypassed with a small capacitor.

Then I took a look under the chassis. The first thing I noticed was the owner's attempt to balance the two channels. He had fitted a string of additional resistors to one network, amounting in all to about 58,000 ohms, or about 10 times the normal value. This in itself was sufficient to indicate that all was not as it should be, while I also found what appeared to be some irregularities in the wiring of the two feedback lines.

All things considered, I decided that the best thing to do was to wipe the present set-up and start again. Accordingly I disconnected both feedback lines.

Immediately I did, the motor-boating disappeared and both channels showed equal sensitivity. True, the sensitivity was higher than it should have been, but at least I knew that there was no basic fault in either amplifier. Once I sorted out the feedback tangle, all should be well.

As a first step in this direction, I disabled one channel completely by removing both 6GW8s. Then I carefully identified the feedback lead from the output transformer of the remaining channel and, equally carefully, the cathode network of the amplifier stage. Then I connected the feedback while observing the output on the CRO.

The gain of the system dropped sharply, thus indicating that this feedback loop was now correctly phased. More important, it confirmed my other suspicion; that the feedback lines had been cross connected from one channel to the other. That is to say, feedback from the "left" channel had been fed into the "right" circuit, and vice versa.

Which explained a lot of things.

I restored the 6GW8s to the disabled channel, and then disabled the other one in the same way. This time, connection of the feedback brought a loud scream of protest from the speaker. Reversing the voice coil connections cured that and restored the gain of this channel to that of its neighbour.

Finally, a frequency response, power output, and square wave check showed that the amplifier was behaving very

(Continued on Page 97)

# ANNOUNCING!

## the OPENING of
## Encel ELECTRONICS

**SYDNEY STORE**

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# ENCEL ELECTRONICS RECOMMENDS

## PUBLIC ADDRESS SYSTEMS

The latest range of proven A.W.A. public address systems is in stock at Encel Electronics . . . and trained Encel personnel can advise you on the A.W.A. amplifier which will satisfy all your requirements. The model illustrated is the PA 10001B 100 watt system, fitted with the radio tuner model PA449Y. The 50 watt PA1002B is similar in appearance. For smaller stores or offices the 25 watt model PA1003 is extremely popular. If you are considering the purchase of public address equipment, consult Encel Electronics without delay. At your nearest Encel Stereo Centre you will receive skilled technical advice on A.W.A. systems . . . and a cost proposition which will be most attractive! If you cannot call, write for technical specifications and EMQs.

## The REVOX G36

SEMI-PROFESSIONAL
2 or 4 TRACK STEREO AND MON

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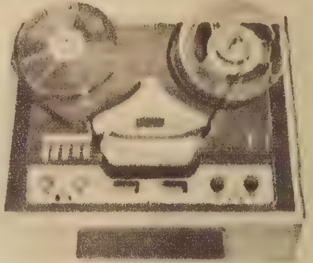
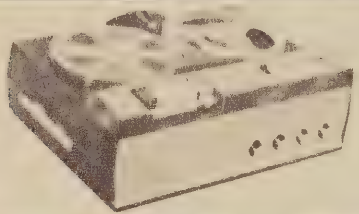
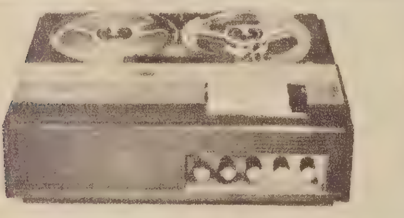


A magnificent but competitively priced professional quality recorder with many unique design features, manufactured by Swiss craftsmen to very close tolerances. Many serious enthusiasts prefer the many features of this 2 speed, 3 motor precision recorder. Write now for an EMQ and ask for a trade-in valuation on your old recorder. Demonstrations at both Encel Stereo Centres.



**Continental 53 (EL3553)**

A two-speed (3¾ and 1 7/8) solid state recorder with 4 tracks and many proven design features. Designed for mono recording and playback, the EL 3553 may be used for stereo playback by using the stereo preamplifier EL 3787. Ask for a no-obligation demonstration.



**Continental 56 Deluxe (EL3556)**

With a frequency range of up to 18,000 c/s, this 4-speed, 4-track recorder provides monitoring through speaker or headphones, separate bass and treble tone controls, full mixing facilities and all other normal Philips features. Styling is extremely modern — the cabinet is selected teak. Write for EMQs, or call for a demonstration.

**Continental 58 Deluxe (EL3558)**

This modern-in-design two-speed, four-track recorder has an extended frequency response—to 15,000 c/s. Features include mixing facilities, monitoring by speaker and headphones, extension speaker socket, a teak cabinet, cardioid moving coil microphone and automatic modulation control. For complete specifications write to Encel Electronics today . . . and ask for an EMQ!

PHILIPS

## new model PHILIPS tape recorders

Here are three new models from Philips . . . the EL 3553, EL 3556 and EL 3558. Encel Electronics can offer you most attractive propositions on these technically advanced and sturdily constructed tape recorders.

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# *Encel Electronics IS Australia's Greatest HI-FI Centre!*

Sounds like an extravagant claim, doesn't it? But it's absolutely true in every respect. From modest beginnings in a small and unpretentious shop in Richmond in the mid-fifties, Encel Electronics has become Australia's Greatest Hi-Fi Centre. In Melbourne five addresses include the Head Office and Showrooms, the new Bourke Street building in the heart of the city, a Bulk Store, the Stereo Assembly Division and the Encel Service Centre. And now our growing Sydney clientele can make their purchases at the new Encel Stereo Centre at 257 Clarence Street, on the ground floor of the 2SM building. Another step forward!

The success of Encel Electronics can be attributed to a merchandising policy founded on fair dealing and faith in the belief that audio enthusiasts everywhere want maximum value for the money expended. There can be no doubt concerning the attraction of the Encel price structure. When combined with effective after-sales service and top trade-in valuations on old equipment, the formula leads inevitably to greater value and greater satisfaction for all Encel Electronics' clientele. And, of course, many Encel components are exclusive to Encel Stereo Centres and are not available elsewhere!

# DANISH HI-FI EQUIPMENT IS POPULAR AT ENCEL ELECTRONICS

ILLUSTRATED IS THE LABCRAFT MODEL 643

A Labcraft
Made in Denmark

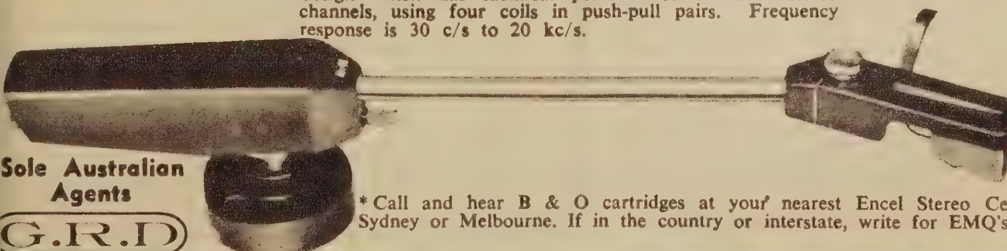
In the lower price category this well-designed Labcraft turntable and pick-up has many enthusiastic supporters. Like the Labcraft 605 it is belt-driven—rumble, wow and flutter have been eliminated. We invite you to compare the rumble evident in the Labcraft 643 with any other turntable in the same price range . . . both when new and after considerable use. The Labcraft 643 has been built to last—the pick-up will accept most good quality cartridges. For budget-priced stereo systems the Labcraft 643 has many advantages. Check Encel prices!

**PLASTIC COVERS.** Dust-proof plastic covers are available for both Labcraft turntables.

## B. & O. CARTRIDGES AND TONE ARMS

**The B & O SP-6.** This new cartridge features a 15 degree vertical playback angle and an exclusive micro-cross armature to permit maximum pickup from the groove with a minimum of crosstalk. Frequency response is 20-20,000 c/s plus or minus 2½ db. The **B & O SP-8** is essentially the same in construction as the SP-6, but is fitted with an elliptical stylus and is pure gold plated. Recommended stylus pressure for the SP-8 is less than 1.5 grams. BOTH CARTRIDGES ARE HIGHLY RECOMMENDED.

**B & O Model SP-1.** A less expensive general purpose stereo magnetic cartridge with excellent performance. It features a symmetrical and accurately balanced moving iron design which has identical performance on both stereo channels, using four coils in push-pull pairs. Frequency response is 30 c/s to 20 kc/s.



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*Call and hear B & O cartridges at your nearest Encel Stereo Centre — in Sydney or Melbourne. If in the country or interstate, write for EMQ's.

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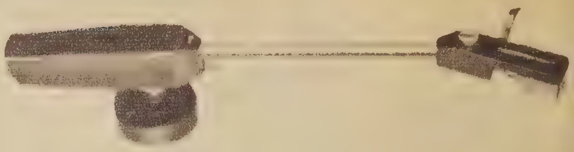
## ENCEL ELECTRONICS RECOMMENDS THE J.H. SYNCHRONOUS TURNTABLE

The lightweight JH turntable is so quiet no known amplifier can provide sufficient bass boost to bring rumble content up to an audible level. Platter diameter is a full 12in—the unit is belt driven—wow and flutter is better than 0.04%. A 12 pole hysteresis synchronous motor causes less vibration than any other gramo unit and is completely **silent.** Encel Electronics pric for this effective turntable is remarkably low—cal and see, or write for an EMQ.

## THE PRIMO A-18 TONE ARM



If you're looking for a low priced tone arm wit many high quality features, the A-18 could be th answer. Both statically and dynamically balance vertical and lateral friction is reduced to negligib proportions. Two slide-on head shells are provide with each arm. Ask for an Encel price or an EM

## JH TONE ARM

The Mk. II JH arm is a development of the original JH arm, and is fully compatible with the ADC .4, and .4E and 10/E cartridges. Write for full specifications.

# PIONEER®

## IF YOU REQUIRE MAXIMUM POWER . . .
## SELECT THE PIONEER SM-83 STEREOPHONIC AMPLIFIER!

Here is a top quality amplifier designed to satisfy the most power-conscious audio enthusiast—for 40 watts are available in each channel. Distortion is negligible even at full power output. The pre-amplifier heaters are supplied with DC to reduce hum content . . . input sens. is 2 mV for magnetic pick-ups. Inputs include Tape head, Tape amplifier, Microphone, Auxiliary, Magnetic and Crystal/Ceramic pick-ups. Write to Encel Electronics for complete specifications and an EMQ. Can you trade-in your old equipment? . . . of course! And Encel trade-in prices are at an all-time high . . . if you're in Melbourne or Sydney bring in your old equipment for an "on-the-spot" valuation. Many professional users now specify this powerful amplifier for their domestic hi-fi systems . . . Listen to the Pioneer SM-83 while you're at your nearest Encel Stereo Centre!

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## SMB-161 STEREO AMPLIFIER/TUNER.

The Pioneer SMB-161 Stereophonic Amplifier/Tuner be a most effective heart for any budget priced ste system. Stereo AM tuners are incorporated—and tuners for two SW bands. Many Pioneer SMB-161's h been built into Encel Stereo Systems. Output is appr mately 11 watts (max.) per channel—input sensitivity magnetic pick-up is 2mV, for crystal pick-up 23mV. F quency response is 20 c/s—60,000 c/s. Write for technical specifications or an EMQ—or if you are a call into either the Melbourne or Sydney Encel Ste Centres for a no-obligation demonstration.

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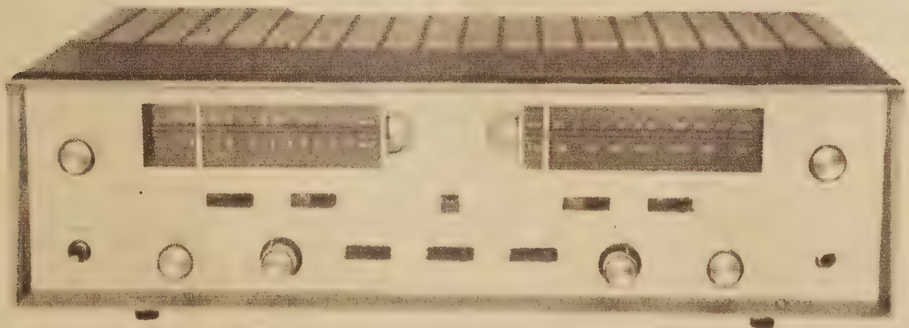
# PIONEER

## THE PRINCE OF THE PIONEER RANGE . . . THE FEATURE PACKED SMQ-300B

With more than adequate output of 20 watts (max.) in each channel, the versatile SMQ-300B has every desirable feature and control to promote listening pleasure. Patented circuitry and precision engineering are part of the secret of the success of this fine amplifier—the balance lies in attention to manufacturing detail. 19 valves are used and 6 semi-conductors. Stereo tuners are AM/AM/FM/SW—frequency response is 20-50,000 c/s, plus or minus only 1 db! Mode-blend, loudness, scratch and rumble controls are all incorporated in the advanced design of the Pioneer SMQ-300B. Write for complete specifications and an EMQ. Encel prices are unbeatable . . . and trade-in valuations are at an all-time high!

## HIGH QUALITY AT MEDIUM PRICE! PIONEER STEREO AMPLIFIER/ TUNER . . . SMG-204B



This popular model from the Pioneer range offers a higher power output than the SMB-161—and AM/AM/FM/SW tuners. It is equipped with loudness control, rumble and scratch filters, bandwidth switches, tape monitor switches and the Pioneer SMG-204B is extremely dependable and easy to operate. The audio depth and presence is quite remarkable. There is no equivalent stereo combination which offers as much value for every dollar expended . . . this claim is easily substantiated—write for your EMQ and we are sure you will agree! If you have obsolete equipment you wish to trade-in on a new Pioneer SMG-204B, we know the Encel Electronics trade-in valuations will be quite unbeatable. Ask for an estimate! If you are in Sydney or Melbourne, come and hear this fine Pioneer unit with pick-ups and speaker systems of your own choice—simply call at your nearest Encel Stereo Centre.

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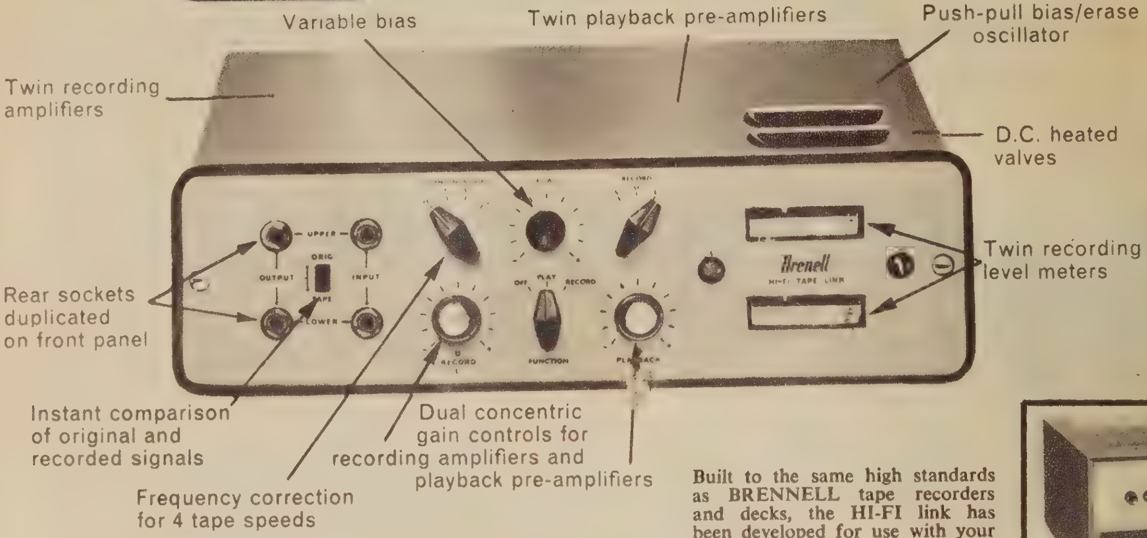
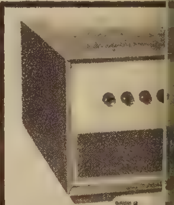
# The Brenell MONO/STEREO HI-FI TAPE LINK


Variable bias
Twin playback pre-amplifiers
Push-pull bias/erase oscillator
Twin recording amplifiers
D.C. heated valves
Twin recording level meters
Rear sockets duplicated on front panel
Instant comparison of original and recorded signals
Dual concentric gain controls for recording amplifiers and playback pre-amplifiers
Frequency correction for 4 tape speeds
Brenell HI-FI TAPE LINK
OUTPUT
INPUT
UPPER
LOWER
ORIG
TAPE
RECORD
FUNCTION
PLAYBACK
OFF
PLAY
RECORD

*Designed for use with 2/2 or 2/4 track heads*

Built to the same high standards as BRENNELL tape recorders and decks, the HI-FI link has been developed for use with your high-fidelity equipment. When used with a BRENNELL Mk. V Series 3 tape deck, performance is almost unbelievable. Write for full details and an Encell Mail Quote (EMQ).

OF



The
60-watt S

## THE LEAK STEREO 30

LEAK amplifiers are probably the most popular prestige amplifier in the Encel range of fine audio equipment. The fully transistorised "Stereo 30" fully maintains all the famous LEAK traditions established with the introduction of the Point One Leak amplifiers in 1945. Recently Mr Harold Leak said, "This is the finest amplifier we have ever designed!" . . and the numbers of Leak Stereo 30 amplifiers sold by Encel Electronics endorse Mr H. J. Leak's testimony. Call and hear the Stereo 30 with any pick-ups or speakers of your choice at Encel Stereo Centres in Sydney or Melbourne. If in the country or interstate, write for EMQ's on Leak amplifiers and, of course, the Mk. II Leak Sandwich Speaker System.

## LEAK SANDWICH SPEAKER SYSTEM MK.II

Although the overall frequency response of the Leak Sandwich extends from less than 30c/s to over 20,000c/s, between 50c/s and 15,000c/s the response is **substantially linear.** When the original Leak Sandwich was introduced it was described as "a totally new concept in sound reproduction." The unique piston action bass speaker was the first major advance in speaker design for over 30 years . . . and now the Sandwich **Mk. II** is better than ever. Ask for an Encel price—or write for an EMQ. Discriminating music lovers can purchase Leak Sandwich Systems from Encel Electronics at Australia's most competitive prices.

## TANDBERG TAPE RECORDERS

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reproduction, your choice must
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corders simply reproduce the sou
of the original performance. No
ing is added — nothing remov
Encel Electronics have found Ta
berg recorders to be functional
operation and design — the dem
being mainly for the models 74B
64. The 74B may be used for h
fidelity recording in stereo and
language study. Either unit may
incorporated in Encel Stereo Syst
or purchased separately. Write
call for full technical details
prices.

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S.E
UTORS

.A.
TRALIA
LTD.

**BRENELL**

MARK 5
SERIES 3

MONO — HALF TRACK — TWO HEADS — MAGIC EYE.
(Available with recording level meter at extra cost.)

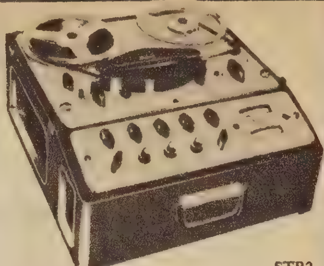
High quality amplifier with power output of 2½ watts r.m.s. and a frequency response of 40-20,000 c/s—can be used independently of tape recorder —narrow gapped record/playback head for extended frequency response — double gapped ferrite erase head to minimise erase noise — headphone monitoring.

**BRENELL**

MARK 5
TYPE M SERIES 3

MONO — HALF TRACK — THREE HEADS — RECORDING LEVEL METER.

Separate record and playback heads—separate record and playback amplifiers — amplifier frequency response 25-26,000 c/s plus/minus 3dB — power output 2 watts r.m.s.—separate bass and treble controls — mixing of input signals — speaker monitoring whilst recording.



STB2

MONO/STEREO — HALF TRACK (Record/playback) — QUARTER TRACK (playback) FOUR HEADS— TWO EDGEWISE METERS.

Designed for use with high fidelity stereo installations — adjustable attenuators on all input channels — dual concentric recording/playback level controls — cathode follower output — 4-channel mixing on mono programmes — twin recording, twin playback pre-amplifiers — adjustable bias level — sound-on-sound facilities. **Optional extra: stereo power amplifiers and monitoring speakers.**

**X-101-C**
**Control-Amplifier**

With heavy-duty output circuitry, exclusive hinged cover over the less frequently used controls, centre-channel output for optional third speaker, front-panel headphone jack, complete phono and tape facilities. **$296.** Write for full details and an EMQ. If in Melbourne or Sydney, call at your nearest Encel Stereo Centre.

**The Fisher X-100-A**
**40-watt Stereo Control-Amplifier**

With large output transformers, advanced control features, front-panel headphone jack, complete phono and tape facilities: **$240.** Contact Encel Electronics now for full details and an EMQ . . . or call at either Encel Stereo Centre.

## WHARFEDALE SPEAKERS — for greater clarity!

Encel Electronics maintains a complete range of Wharfedale speakers and Wharfedale speaker systems. At the moment the new "Linton" is very popular—for this compact system offers higher sensitivity and effective bass performance. Frequency range of the "Linton" is 40-15,000 c/s and power handling capacity 10 watts RMS. The new "Super Series" is also an Encel best-seller. Audio engineers and music lovers enthuse over Wharfedale clarity—right through the frequency range. Exclusive roll surrounds permit maximum cone excursion in sealed or air-tight enclosures — and high frequency response is well maintained through the use of the unique Wharfedale double diaphragm principle. Before you invest in Wharfedale speakers, be sure to get an Encel price or an Encel Mail Quote (EMQ). You will be well rewarded for your trouble!

## ORTOFON PICK-UPS AND CARTRIDGES . . . DISTORTION FREE!

Over 90 per cent of Australian professional users . . . the broadcasting and television stations, as well as recording studios—have standardised on ORTOFON moving coil pick-ups. The ORTOFON moving coil system is inherently more linear—and absolutely **free from distortion.** The ORTOFON SPU series has been very popular at Encel Electronics—many music lovers have purchased the ORTOFON SPU-GT-E cartridge with the elliptical stylus. The most popular ORTOFON tone arm is the SMG 212. Call at the Melbourne or Sydney Encel Stereo Centre for catalogues and prices of ORTOFON equipment—or write for EMQ's. You can up-grade your equipment to ORTOFON for less than you thought possible!

## ORPHEUS TURNTABLES ARE COMPLETELY SILENT!

The Orpheus Silex transcription turntable is in constant demand by Encel Electronics clients. Well designed and magnificently engineered, this fine unit has many unique design features . . . belt drive, motor and pickup completely isolated from their surroundings to eliminate rumble, hum and noise . . . wow and flutter guaranteed less than 0.09% . . . 4 speeds with variable speed control . . . and many more. The Encel price on Orpheus equipment must be of intense interest to the music lover . . . so call or write for EMQ today!

# ENCEL

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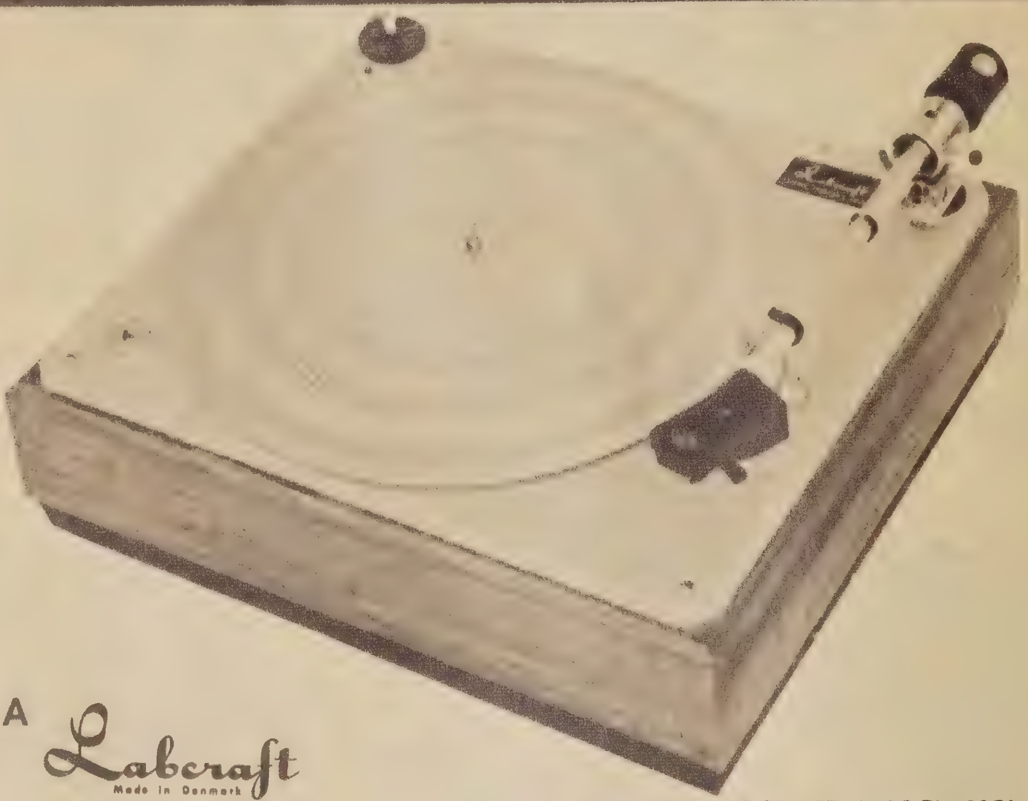
# DANISH HI-FI EQUIPMENT IS POPULAR AT ENCEL ELECTRONICS



A Labcraft

Made in Denmark

**Illustrated is the LABCRAFT MODEL 605L**

Illustrated is the Labcraft Model 605L transcription turntable fitted with the well known All-Balance tone arm and the hydraulic microlift. The **605L** is belt driven and incorporates a patented motor suspension which isolates all vibration from the base plate, tone arm and turntable. Rumble, wow and flutter are non-existent. Speed variation is applicable to all four speeds—and this medium price unit is an Encel best-seller. Write for full details and prices. The **All-Balance** tone arm will track perfectly at less than one gram, and will accept any high compliance cartridge in the new All-Balance head shell. Stylus pressure may be adjusted up to four grams . . . . Encel Electronics do not hesitate in recommending this proven tone arm for use with most stereo cartridges. The **Microlift** is an optional fitting to facilitate handling of the pick-up.

**Pre-amplifier.** A printed circuit transistorised pre-amplifier may be fitted to the Labcraft 605 and 605L turntables to provide additional gain for magnetic cartridges such as the B and O, Shure, ADC, etc. Two transistors are used in each channel, RIAA equalisation being made through a feedback circuit. Power supply for the pre-amp is taken from a special winding on the turntable motor. The unit fits under the baseplate. Write for prices and detailed specifications, or call at either Melbourne or Sydney Encel Stereo Centres.

Australian Mountain Ash bases (as illustrated) are available for Labcraft turntables. Ask for prices for polished and unpolished bases for either model.

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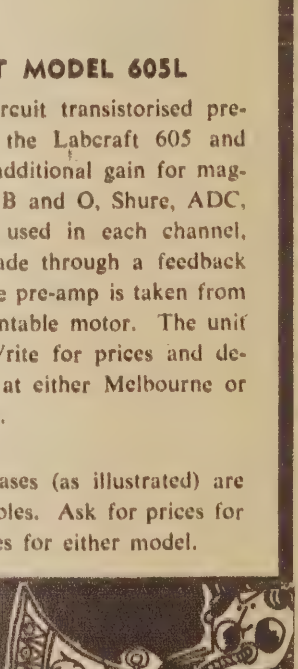


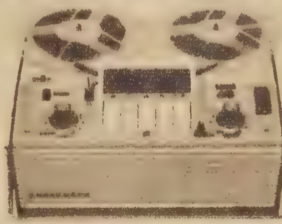
# ENCEL ELECTRONICS CAN BE YOUR "NATIONAL" SERVICE CENTRE!

**NATIONAL** National **NATIONAL**

If you prefer NATIONAL tape recorders and are considering the purchase of new equipment, you will be well rewarded when you visit your nearest Encel Stereo Centre. Although all current models are in stock, here are brief descriptions of four best selling NATIONAL tape recorders — the RQ-703S and the RS-755S are particularly popular. If you have the opportunity, hear these fine recorders at your nearest Encel Stereo Centre . . . or write for an EMQ and fully descriptive brochures.

## NATIONAL RQ-503S

A completely transistorised tape recorder with many outstanding design features. These include capstan drive, two speeds—3¾ and 1⅞ ips, pause lever, tone control, tape counter, foolproof recording switch, push-button operation. Takes up to 5in tape spools. AC operation only.

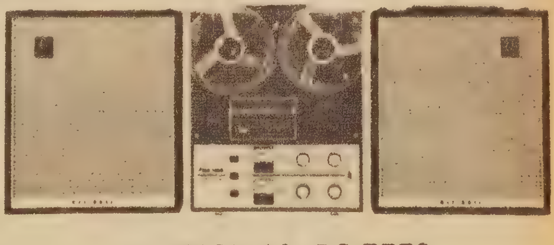


## NATIONAL RQ-705

A budget priced monaural recorder for the amateur . . . completely push-button operated and takes 7in tape spools. Two speeds — 7½ and 3¾ ips. Features include a digital tape counter, foolproof recording switch, pause lever and tone control. Frequency response: 100-15,000 c./s. at 7½ ips.

## NATIONAL RQ-703S

A three-speed bush-button operated recorder with all the features of lower priced models — takes 7in tape spools. Makes a particularly effective P.A. system. Frequency response is 100-15,000 c./s. at 7½ i.p.s.



## NATIONAL RS-755S

A professional quality stereo solid state recorder with 4-track configuration and two high fidelity speaker systems. Two speeds—7½ and 3¾ ips. Frequency response: 60-15,000 c./s. at 7½ ips. Two large VU meters are incorporated . . . and many other advanced design features. Write for trade-in valuations on your old equipment — or call at your nearest Encel Stereo Centre.

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# ADC CARTRIDGES GIVE OUTSTANDING PERFORMANCE

## . . . AND ALL MODELS FEATURE MINIMUM STYLUS MASS

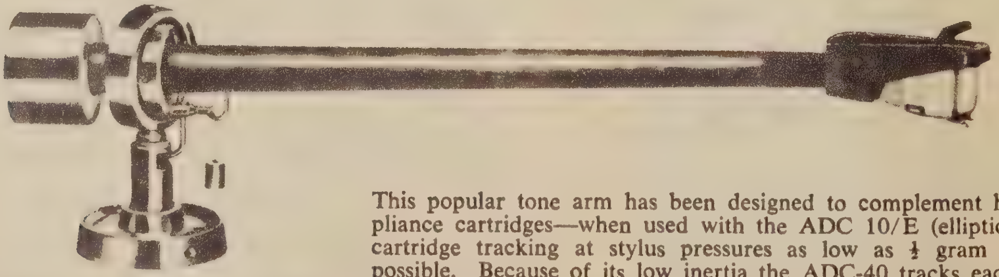
The main characteristics of an ideal stereo cartridge are (i) stylus mass must be minimised (ii) stylus compliance must be at maximum (iii) a standard vertical tracking angle should be adopted. Distortion can only be eliminated when the cartridge can trace the exact shape of the record groove and reproduce its precise electrical analogy. ADC cartridges completely satisfy all these requirements with the revolutionary "induced magnet" principle. Encel Electronics has now sold many thousands of ADC units . . . from the low priced ADC 770 to the new ADC 10/E. The proof of ADC's success is in the wide acceptance and popularity of these advanced cartridges with the Australan music lover and audio enthusiast. Encel Electronics offers the best deal in Australia on any of the six ADC cartridges — the ADC 10/E (elliptical stylus), ADC Point Four E (elliptical stylus), ADC Point Four, ADC 660E (elliptical stylus), ADC 660 and the ADC 770. Write or call for complete specifications on all ADC "Induced Magnet" cartridges . . . if in Sydney or Melbourne call at your Encel Stereo Centre . . . or if you wish write for an EMQ. We know you'll be more than delighted with ADC performance and the Encel prices.

**READ THESE COMMENTS ON ADC CARTRIDGES TAKEN FROM LEADING OVERSEAS PUBLICATIONS:—**

**THE GRAMOPHONE.** "A masterpiece of design listening tests have confirmed these outstanding results (lab. tests) . . . it is to the credit of ADC that they have made an advanced model available to those who wish to be ahead of the times . . ."

**AUDIO AND RECORD REVIEW.** "If this reads like a rave review you are not mistaken . . . extended trials have not altered our opinion, in fact, our admiration has increased . . . comes right at the top of the tree . . . . we cannot recall having tested a stereo pick-up with such a remarkable performance."

# ADC-40 *Pritchard* TONE ARM



This popular tone arm has been designed to complement high compliance cartridges—when used with the ADC 10/E (elliptical stylus) cartridge tracking at stylus pressures as low as ½ gram are quite possible. Because of its low inertia the ADC-40 tracks each side of the record groove perfectly—record wear is negligible and the standard of reproduction is outstanding! Encel Electronics recommend the "Pritchard" arm for use with all ADC cartridges—particularly the ADC 10/E, the Point Four E and the Point Four. Fine cartridges demand equally fine tone arms . . . and the Encel price will be less than you might reasonably expect. Write for complete specifications and an EMQ, or call at the Sydney or Melbourne Encel Stereo Centres.

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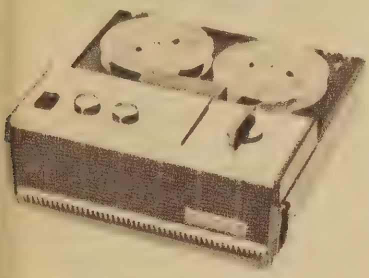
# BUYING A SONY TAPE RECORDER?

***ENCEL ELECTRONICS MAKES THE PURCHASE OF SONY TAPE RECORDERS SO MUCH EASIER !***

**Here we have illustrated four of the most popular SONY recorders in the vast range you'll find at either Encel Stereo Centre. Call and hear them . . . or write to Encel Electronics for an EMQ. If ordering from interstate, please give us your name and address in BLOCK LETTERS. "SONY" tape recorders are care-packed and freighted anywhere in Australasia.**

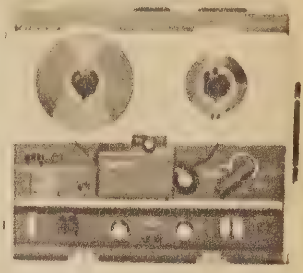


**THE SONY-O-MATIC TC-900**

Featuring the Sony-o-matic automatic level control recording system, this compact and portable recorder operates from its own batteries or from an AC point. Two speeds — fully transistorised—two track recording and playback — supplied complete with dynamic microphone, batteries and carry-and-protect transit bag. Buy the TC-900 better at your nearest Encel Stereo Centre!

**THE SONY-O-MATIC TC357/4**

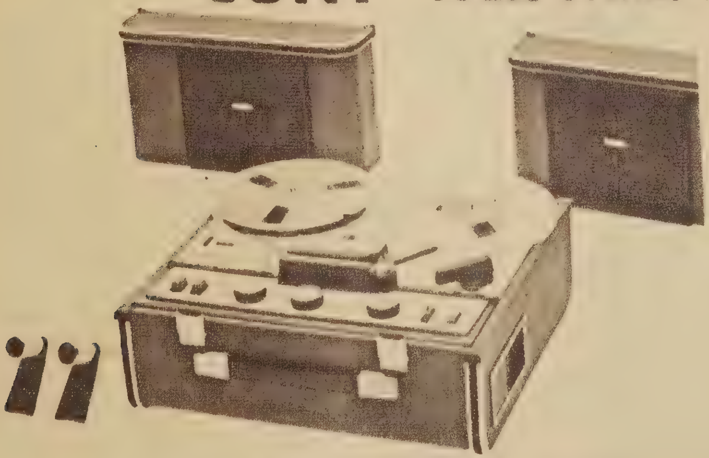
With a completely automatic recording level control system, this versatile 4 track monaural recorder offers many advanced electronic and engineering features to the enthusiast. Reels are self-threading, 3 speeds are available, many more features are incorporated. Frequency response is 40-15,000 c/s at 7½ ips, 40-12,000 c/s at 3¾ ips. Ask for an EMQ on this fine SONY instrument — or for an Encel trade-in valuation.



**THE SONY TC-500A**

An outstanding high fidelity stereo recorder for 4 track stereophonic or monaural operation. Twin full range speaker systems are supplied — and two SONY F-96 dynamic probe microphones. Frequency response is 30-18,000 c/s at 7½ ips. Signal to noise is 50 db per channel. Please contact us for complete and unabridged technical specifications — and for trade-in valuations and an EMQ. There are so many outstanding features in this fine SONY unit space will not allow us to do justice to it! Write or call now . . .

## *FOR OUTSTANDING QUALITY & PERFORMANCE INVEST IN THE* SONY TC-200 STEREO RECORDER



Here is a completely portable SONY 4 track stereophonic tape recorder with twin wide range speaker systems and a multitude of design and operating features. Two SONY F-96 dynamic microphones are supplied — frequency response is 50=14,000 c/s at 7½ ips. Write to Encel Electronics for complete specifications—or call and hear the TC-200 at either Encel Stereo Centre in Melbourne, or at the new Encel store on the ground floor of the 2SM building, 257 Clarence Street, Sydney. Write for an EMQ and a trade-in valuation on your old tape recorder.

**A COMPLETE RANGE OF SONY TAPE RECORDERS IS ALWAYS IN STOCK AT ENCEL ELECTRONICS . . . THE FOUR MODELS ILLUSTRATED ARE THE MOST POPULAR!**

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# NEW PRODUCTS FROM KELLY ACOUSTICS!

## THE ACOUSTIC LENS

Specially developed for use with the Kelly Ribbon Tweeter, the Acoustic Lens provides optimum dispersion of higher audio frequencies. It is made from high density plastic and fits to the front of the tweeter. Up to 15 kc/s the coverage pattern is constant within 3 db over 150 degrees.

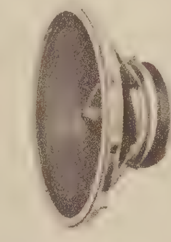
Encel price: $10 (£5).

## NEW MODEL KELLY MK V BASS SPEAKER

This new 12in woofer has a basic resonance of 25 c/s and a total flux of 250,000 maxwells with a new magnet assembly. Frequency range is 30-5,000 c/s . . . but crossover is designed for 2500 c/s. Power rating is 35 watts — use being made of a new laminated former with the voice coil actually embedded in polyester resin, allowing greater power output than normal. Transient peaks of 100 watts will not damage the assembly.

Encel price: $45 (£22/10/).

## NEW 15" WOOFER SPEAKER (Mk. V11)



This new Kelly speaker is rated at 50 watts—cone resonance is 20 c/s. Frequency response is 30-5,000 c/s — total flux 350,000 maxwells. Recommended crossover frequency is 2,500 c/s. The Mk. VII uses a laminated aluminium former with the voice coil embedded in polyester resin—the metal core acts as a heat sink allowing larger power outputs than normal.

Encel price:
$55 (£27/10/).

## KELLY CROSSOVER NETWORKS
**At 2500 c/s. $11 (£5.10.0)**

## FISHER AMPLIFIERS

A complete range of Fisher amplifiers are available. Write for EMQ'S (Encel Mail Quotes) or trade-in valuations on your old equipment.

## Acoustech Amplifiers

Encel Electronics has been appointed Australian Distributor of these famous American amplifiers. Many leading reviewers use Acoustech equipment for personal listening . . . and the new solid state Acoustech units are outstanding. The first shipment sold out quickly — please write for prices and specifications — or call at either Sydney or Melbourne Encel Stereo Centres.

## TAPE RECORDERS

Although our range of tape recorders is extremely wide, Encel prices are wider still —starting at $37. Advertising prices is forbidden by trade associations — but Encel Electronics sales are at an all time high! Stock now includes: Revox G36, two and four track — Tandberg 64 and 74B — Beo-Cord 2000 and 1500 — Akai M8, X4, 355, 1700 — Sony 500a, 200, 357/4, etc. — National 703S, 705, 755S, etc. — All Philips new models — Ferguson — Truvox — Grundig — and many more. You'll **save more** at Encel Electronics!

## TAPE DECKS

The Grundig TM45 deck (as used in the TK46 recorder which sells for $480) is now selling at $171. Normal retail is $241.50. Also in stock — Sony TC250a and Collaro. Write for EMQ's.

## Encel Service Division

In Melbourne a complete Encel Service Centre is maintained . . . situated at 361 Bridge Rd., Richmond. A staff of seven including four fully trained technicians assures Encel clients of prompt, efficient attention if ever necessary. In Sydney service is available through the Encel Stereo Centre at 257 Clarence Street.

## Cameras and Projectors

A wide range of photographic equipment — cameras, projector, etc. — is now in stock. Leading manufacturers from the Continent and Japan are represented — most popular makes are available. All equipment is BRAND NEW and guaranteed. Ask for quotes on the photographic equipment you need — or write for EMQ's. Sorry — we cannot give telephone quotations — trade associations frown on this practice.

## CELESTION SPEAKERS AND SPEAKER SYSTEMS

Encel Electronics is the Australian Distributor for Celestion products — and all models have found wide acceptance in Australia. High sales volume is maintained by Encel Electronics' low price structure. Compare the value!

Now available in Australia'

**CX 1512 Standard "Studio Series" Co-axial 12in Speaker.** Frequency response is conservatively quoted at 30-15,000 c/s. Rating: 15 watts RMS. Features a pressure type tweeter with an electrical crossover at 4 kc/s. Performs very well in a 3 or 4 cu. ft. enclosure. $39.50.

**CX 2012 De-Luxe "Studio Series" Co-axial 12in Speaker.** Greater total flux gives the CX 2012 a frequency response conservatively quoted at 30-18,000 c/s and a rating of 20 watts RMS. An exponential horn pressure type tweeter has a crossover frequency of 4 kc/s. This fine speaker is worthy of the most advanced high fidelity system.

## LIFT HF PERFORMANCE WITH THE NEW CELESTION TWEETER!

If treble response sounds "flat," add a Celestion HF1300 tweeter! Patterned on the well known GEC BSC 1852, frequency response is level within plus or minus 2 db from 1500 c/s to 13 kc/s and extends well over 15 kc/s. Simply connected to any speaker via a capacitor supplied free of charge.

Encel price: $15.

# PRE-RELEASE INFORMATION

A completely **new** stereo amplifier — with a multitude of features. THE NEW ENCEL M.F.B. STEREO!

Never before has an amplifier been available with so many features at this price —and orders may be placed now for early delivery. Output is 20 watts (peak) in each channel, frequency response is 20—40,000 c/s. **Input sensitivities are:** Mag. pick-up 2mV, Tape Head 1.5mV, Crystal pick-up 40mV, Microphone 15mV, Tuner 70mV and Auxiliary 70mV. **Special features:** Loudness control, rumble filter, scratch filter, tape monitor, a balance meter which can be switched in and out of circuit, headset socket, high quality and substantial output transformers, channel indicators, etc. Valve complement: 4 x 6BQ5, 5 x 12AX7, 2 x silicon diodes.

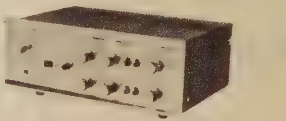
**M.F.B. Circuit:** Motional Feedback Circuits and Control are bonus features of this fine amplifier.

Apart from many advanced technical features in circuitry, the new Encel M.F.B. Stereo amplifier also is extremely satisfying from an acoustic point of view — it's ver easy to listen to with good speaker systems.

**Encel Price: $115 (£57/10/-)**

**Delivery:** The first deliveries to Encel clients should be made on June 15th. Place your order now!

## COMING SOON!
## THE ALL NEW LUX SOLID STATE STEREO AMPLIFIER WITH SILICON TRANSISTORS AND 80 WATTS PEAK POWER OUTPUT!



The first LUX fully transistorised amplifier available in Australia (the Model SQ11) proved to be one of the most popular Encel stereo ampliifers—and now the new silicon transistor LUX amplifier has been developed. The first shipment is on the water. Input sensititivities are:— Magnetic pick-up: 3.5mV, Tape Head: 1.8 mV and 2.1mV, Tuner or Auxiliary: 250 mV. Features include . . . Treble Filter, Rumble Filter, Tape Monitor, Mode Control, Headset Jack, Phase Switch, etc. A new type tone control enables variable frequency crossover in both treble and bass. LF switching is at 150c/s, 300c/s, 600c/s and Delete . . . HF switching is at 1.5kc/s, 3kc/s, 6kc/s and Delete. Order your new LUX stereo amplifier now for early delivery.

## THE CELESTION "DITTON 10" SPEAKER SYSTEM

Measuring only 12¾in x 6¼in x 8¼in, the "Ditton 10" is regarded as one of the most advanced compact speaker systems. Frequency response: 35-15,000 c/s. Available in oiled teak or walnut cabinets. See the reviews in "The Gramophone," p. 41, June, 1965, and "Hi-Fi News," p. 433, October, 1965. Outstanding stereo dispersion may be obtained by using a Celestion CX2012 in a 4 cu. ft. enclosure centred between two "Ditton 10" systems. Price of the "Ditton 10": $59.

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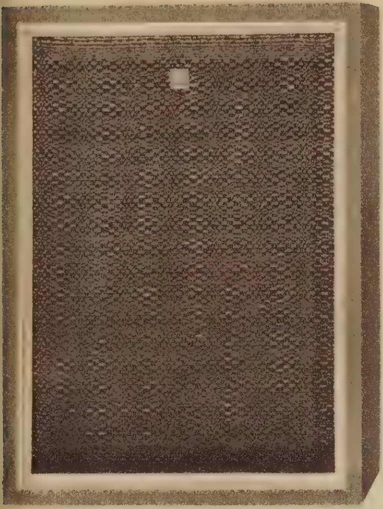
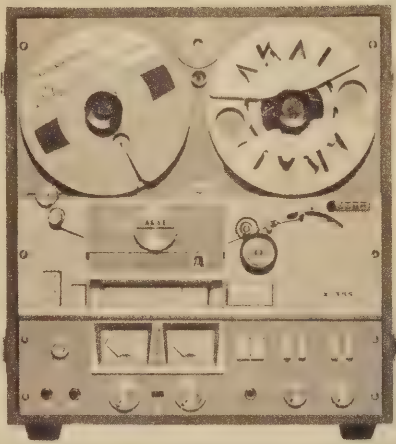
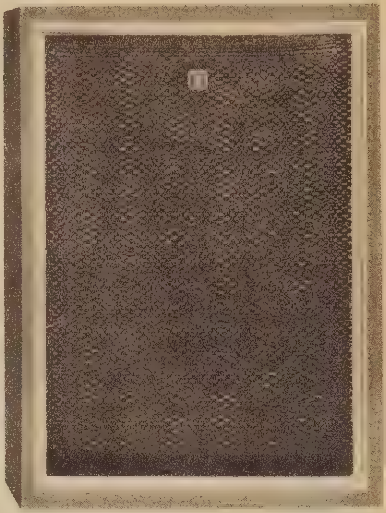
# WITH PRIDE WE OFFER TAPE RECORDERS OF REAL QUALITY



MODEL SW—130



AKAI MODEL **X-355**



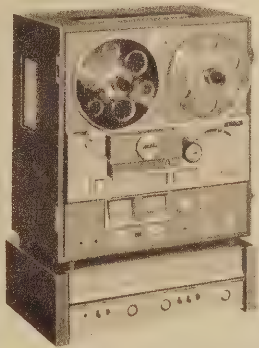
MODEL SW—130

This is the highest quality Japanese tape recorder on the market. The Akai Electric Company created this 4 track, 3 speed stereo tape recorder for professional audio use. The X-355's solid state amplifier produces 50 watts of music power. (Attach a tuner and this amplifier doubles as an excellent FM AM radio). This tape recorder features the famous Akai Cross Field Head, which records from 30 to 24,000 cycles at 7½ips, plus separate play-back and erase heads. You can take sound-on-sound and sound-with-sound, as well as enjoy an echo chamber effect, if you wish. The dial found at the top is the automatic reverse, repeat and shut-off control. Other important features include the 10½" reel and the remote control capability. If you wish to own a 62.7lb sound studio, call at your nearest Encel Stereo Centre in Sydney or Melbourne.

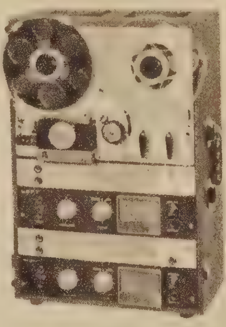
---

PRE-MAIN AMPLIFIER
MODEL AA-5000

- ✻ Solid State Stereo
- ✻ 110 W Music Power
- ✻ Silicon Power Transistors
- ✻ Electronics Protection Circuit
- ✻ Filters for High and Low
- ✻ Completely O.T.L. System, Distortion-free, Well Damped Reproduction
- ✻ Din Jack Connection
- ✻ Speaker Connection Jack
- ✻ *Perfect sounds when used in combination with Tape Deck X-355D*



AKAI MODEL **X-355D**
MODEL **AA-5000**



AKAI MODEL **M-8**

CROSS-FIELD HEAD PLUS VERTICAL STELEO

- ✻ 4 Track Stereo Monaural Record and Play
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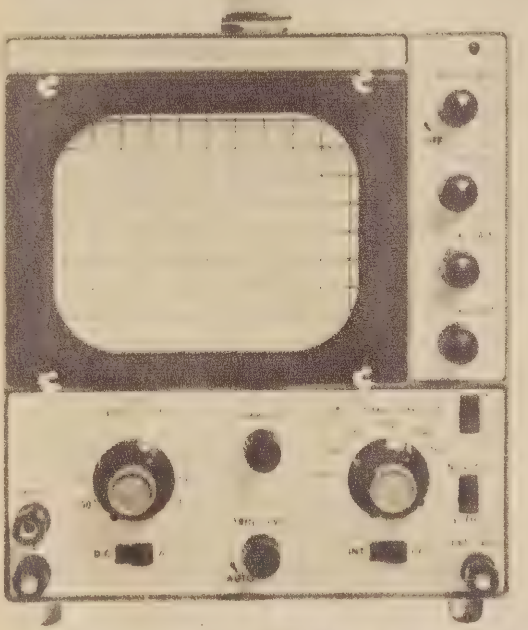

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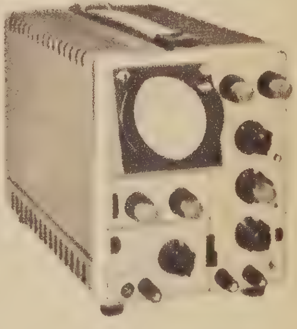

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# SERVICEMAN — Continued

well indeed, and I returned it to the customer with a few words of advice about feedback networks, and the pitfalls associated therewith.

However, there are a couple of interesting points about the story which are worth considering. In the first place, how did the customer finish up with this strange configuration?

It is hard to be definite, but my guess is that, initially, he transposed the two feedback lines from one channel to the other. This would be an easy mistake for a beginner to make, remembering that there are four identical valve sockets providing eight valve functions in what thus becomes a fairly compact physical assembly.

Assuming this to be so, and that both feedback lines were connected to the output transformers correctly, according to the colour code, then the end result would have been extremely interesting. For we would have, in effect, two 9W amplifier channels with the output of the "left" connected to the input of the "right," and the output of the "right" connected to the input of the "left": in other words, a high gain, high output multivibrator!

Faced with this dilemma, our friend probably tried reversing the connections to one output transformer. (If he changed both, he would achieve nothing.) This would kill the multivibrator effect, but produce other equally strange effects in regard to the individual amplifiers. In fact, anybody keen on higher mathematics will find this good material with which to while away a wet Sunday afternoon in a padded cell, working out the comings and goings of signals, feedback signals, phases and so on.

However, in simple terms, it would work out something like this. Let's say the left channel had the feedback line so connected to the output transformer that, if connected to its own input circuit, positive feedback would result. Conversely, the right channel feedback connection is so connected that it would give negative feedback if wired correctly.

We would now find that the left channel would have very little gain, because the right channel would be operating as an amplifier in the left channel feedback line, and the overall phase of this loop would be negative. The left channel would thus suffer from an extremely high order of negative feedback.

The right channel amplifier, on the other hand, would suffer from positive feedback, the left channel also functioning as a feedback amplifier but with the overall phase now positive. However, the gain to the left channel being so low (because of of its very high feedback), the actual amount of positive feedback would be small. Thus the gain of the right channel would be similar to, or a little higher than, its "no feedback" condition.

So we have one channel with very high negative feedback, and the other with a small amount of positive feedback. Small wonder that the customer complained of lack of balance!

Another possibility is that, while the two feedback lines were so phased, our friend tried transposing them with respect to the cathode input points, as implied by his statement about "swapping the channels over." If he did, the result would have been positive feedback and violent oscillation in one channel, leading him to believe that this arrangement was wrong when, in fact, it was closer to correct than the previous arrangement.

And what of the low frequency motorboating?

Considering all the ramifications of a hare-brained set-up like this, it would be surprising if the whole thing didn't take off at some frequency. It could have been due to the positive feedback applied to the right channel, although it seems unlikely that conditions would be favourable at such a low frequency.

Another possibility, and a more likely one I think, is that there was some additional coupling between channels via the common power supply. Assuming the phase was right, the order of coupling would tend to increase as the frequency decreased, due to the increasing impedance of the power supply.

Such are the problems which can arise from one initial error.

My next story is on quite a different theme. It tells how a small but obscure fault in a small radio receiver was nearly the means of it being consigned to the local tip . . . and I mean, the local tip.

A customer dropped the set in, one day, with the observation that it had caused him so much trouble that he thought the best thing would be to throw it out with the garbage. Just before taking this drastic step, however, he thought he had better seek my advice — on condition that I did not spend a lot of time and money on the thing.

If it was significant, he and his wife would be away from home for several weeks, so that I could treat it as a kind of "spare time" job.

In fact, the set did sit around my shop for a week or so until an idle half-hour turned up, when I duly picked it up, dusted off the outside and switched it on. It was a typical four-valve mantel superhet, dating back a few years, of well-known brand and of quite respectable appearance.

When it came on, however, the sound was anything but respectable. It made scratching noises when the dial was turned and scratching noises when the dial wasn't turned. It hummed and it was distorted. I could well imagine why the owner had lost patience with it and — apparently — hadn't even tried to use it for several months past.

Certainly not encouraged by what I had heard, I switched it off again and took the chassis out of the cabinet. Not surprisingly, it was thick with grease condensed from kitchen cooking, overlaid with a generous layer of household fluff. I got myself a near case of asthma, wiping and blowing it into a state of respectability. The ganged capacitor, of course, came in for its long-overdue share of "de-lousing."

This done, the set was switched on again, producing less noise when it was tuned across the stations but still with its share of crackle, hum and distortion, which remained even with the volume control turned right back. Out came the test prods.

First poke, after puzzling my way around the sockets, established that the high-tension voltage on the 6M5 output valve screen was rather low (about 150) while the plate voltage was both low and rather uncertain.

At the same time, the voltage drop across the back-bias resistor seemed unduly high to apply to a 6M5 — it was very close to 10 volts negative.

About this time, the phone rang and, when I came back to the set a few minutes later, it was to find the crackling silent, and the distortion gone, along with the hum. And, for the next couple of hours, while I did other things, the set stayed that way.

Seeking an explanation for what I had observed, I could readily accept that dust between the capacitor plates

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would have caused the crackle when tuning. Possibly a dirty valve pin, put right when the valves were withdrawn, cleaned and reinserted, might have accounted for the other crackle. A filter capacitor with high leakage after a long period of idleness could have been responsible both for the limited H.T. voltage and the heavy drop across the back bias resistor. These unnatural voltages would account for the high distortion.

It seemed to add up in a rough sort of way, so I put the set back in its cabinet, and let it run — which it did quite normally — until I shut up shop for the night. Nevertheless, I didn't immediately write out the account. Somehow, against the sorry tale which I had been told, it sounded too easy.

Next morning, my intuition was proved to be all too correct for, at first switch on, the set began crackling again like a beauty.

Remembering the flickering voltage on the output valve plate, I was prepared to bet that what I was hearing was a good old-fashioned breakdown in the output transformer.

So out came the chassis once again and my eyes, this time, went straight for the output transformer on the back of the loudspeaker. I must confess that I wasn't quite prepared, on closer examination, to find that someone had been there before me: The winding was a replacement type of fairly recent vintage.

Not quite so sure of myself, I nevertheless unhooked the wires to the transformer, discovering in the process that a couple of extra wires went back under the chassis, apparently having to do with some kind of feedback circuit. When I tacked in the leads from a replacement transformer, the immediate effect after switch-on was a loud scream; obviously I had picked the wrong phasing for the transformer wires.

So I switched the secondary connections, which happened to be the most easily get-at-able—and you've guessed it: The set still crackled. At least I didn't have to change the output transformer!

But what next?

Ah yes . . . what about any bypass from the output plate to chassis, or anywhere else?

It turned out that there was one, a paper capacitor going back to chassis via a resistor, evidently a kind of step circuit. But this, too, was a new component and had obviously been replaced during the last couple of years. Disconnecting it proved that it had nothing to do with the crackling.

Well then, if it wasn't the output transformer or the plate bypass and it was in the output section of the receiver, the next obvious thing to suspect was the valve itself. So I reached for a new one, only to find that the cupboard was bare. As Hermann Munster would say, "Darn, darn, darn, darn."

Of course, there was just the possibility that it could have been a socket fault and, without any great conviction, I pulled the valve out and looked at the socket. Curiously, there was a ring of "goo" around one of the socket holes—around the grid hole in fact.

And when I turned the valve over, there was a similar contamination around the grid pin on the underside of the glass.

Suddenly the bells started ringing—clang, clang, clang. When I had cleaned as much of the "goo" as would come easily off the base of the valve, I was left with a silvery looking deposit around the grid pin, which seemed to be deeply ingrained in the glass. It was another example of what I mentioned in these columns quite some time ago (April, 1959), migration of the silver coating from the valve pin to an adjacent surface.

No wonder that there is a tendency by some communication organisations to outlaw silver plating from their connectors.

In this case, I hopefully scraped the glass around the grid pin good and hard with the tip of a tool and just as assiduously cleaned the surface of the socket. When the valve was replaced and the set switched on, it worked like a charm and has continued to do so, ever since, in the owner's home.

Looking back, it seems that a near-molecular film of silver between the grid pin and the adjacent screen pin had produced the original crackling symptoms. In the effort to cure the trouble another serviceman (or servicemen) had applied the logical cures of replacing the output transformer and plate bypass; and the chances are that the measure seemed to effect a cure, because the mechanical disturbance of the chassis had temporarily interrupted the leakage path.

I had had much the same experience with my dedusting operations but I had been luckier in that the trouble reasserted itself almost immediately and while the set was still in my hands. Even then, had it not been for the fact that I was temporarily out of stock of 6M5s, I might have cured the trouble by replacing a valve, never realising that it could have been cured just as effectively with a good hard scrape to get rid of a silver deposit.

Such is the luck of the game!

Incidentally, after I had written the above story, I checked back through my files to find the April 1959 reference which I had temporarily left blank. I'm afraid it came as quite a shock to find out how similar were the two stories; the same 6M5 valve, the same symptoms, the same tell tale ring around the grid pin and even the same situation whereby no replacement was immediately available. The cure was similar also, except that, on that occasion, I had no idea of the nature of the contamination. This time I did.

However, I can assure readers that they were two completely separate incidents; so well separated in fact that I had completely forgotten the first one until circumstances almost forced the recollection upon me.

I must be getting old.

And, to finish off, here are some thoughts on the lighter side.

Amateur radio operators are sometimes accused of causing TVI (television interference) and are always conscious of this problem when putting new equipment into use.

However, according to a report in a recent copy of "Electronics World" some TV sets are unduly sensitive to another form of interference, tentatively called "Snee-Zee-I." I quote:

"Among the first reported victims is W8YGI, James Abbott, of Michigan. One evening, he and his wife were engrossed in an exciting whodunit on the local Channel 2. Suddenly, Mr Abbott was seized with a severe fit of sneezing. When he regained his composure, the screen displayed a Channel 7 wrestling match. Supersonic components of the sneezes had triggered the receiver's remote tuning mechanism.

"Luckily, there is a simple cure. A low-pass filter, fashioned from a large handkerchief or a number of facial tissues, can be placed over the face to muffle the high frequencies generated by even the most powerful sneeze.

"Owners of supersonically tuned TV sets and who suffer from hay fever or the common cold are advised to keep a supply of these filters on hand at all times. Otherwise a great deal of friction may arise between the channel-switching sneezer and those members of the family who enjoy looking at a single program from beginning to end." ■

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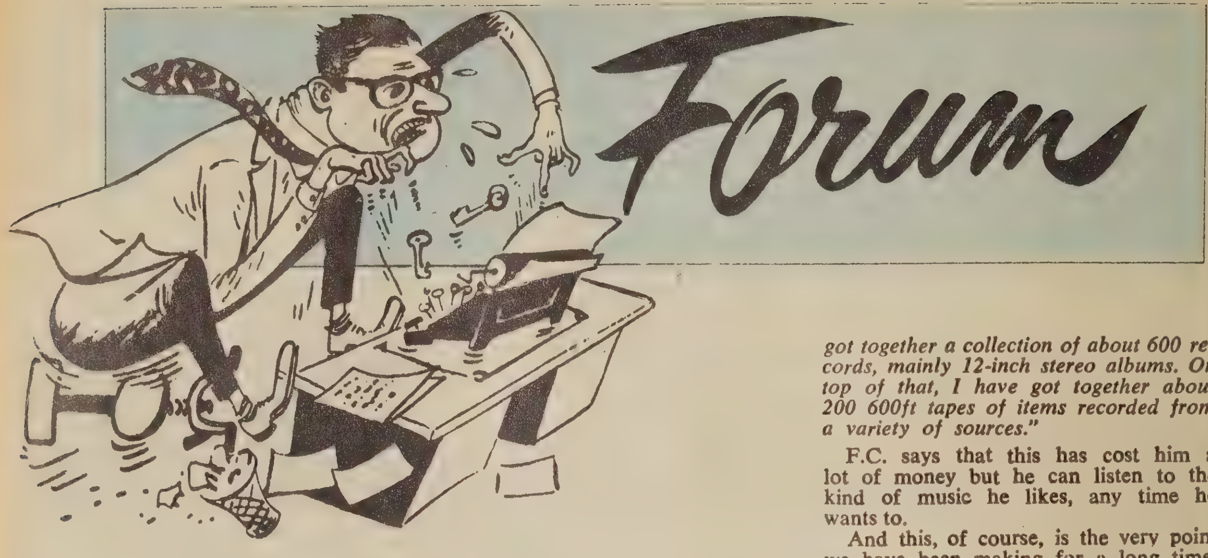


# Forum

One of the by-products of recent discussion of FM-Stereo, tape cassettes and "pirate" radio stations has been a series of observations by correspondents about inadequate service from AM radio stations.

### By W. N. Williams

From Cairns, North Queensland, a reader (H.H.) has this to say:

*"I can't feel the least bit sympathetic towards listeners in Sydney who have lost their precious FM broadcasts. Do you realise that the A.B.C. regional stations in Queensland broadcast the same program and that there is normally only one station (4QG) situated in Brisbane, which normally broadcasts an alternative program designed for the more intelligent listeners.*

*"A glance at the map will show what chance we in Cairns have of receiving 4QG directly. To add injury to insult, the A.B.C. puts this one alternative program on a station which is rated at 10KW.*

*"When the local A.B.C. station does broadcast a program I consider worth listening to, the signal has to come over 1,000 miles or more of landline and must suffer some impairment in quality en route. The A.B.C. could surely improve matters for country listeners by sending tape recorded programs to regional stations and have these stations broadcast them in a staggered system so that one could at least get a choice at times by tuning to a station 200 miles away — not 1,000!"*

This same correspondent goes on to say that he does not agree with the often repeated statement that power lines are responsible for the bulk of present-day radio interference. He says:

*"We must face the fact that one cannot expect first class reception outside the primary service area of a transmitter. Power lines are only one of many sources of radio interference and, in fact, supply authorities co-operate very closely with the P.M.G. radio inspectors in minimising sources of interference.*

A reader from Welshpool, Vic., is not nearly so happy about interference from power lines. He explains that he has a pole transformer on his farm property, about 50 feet from the house. This steps down the voltage from "about 13,000" to serve about 26 different farms within a couple of miles radius.

Every now and again, there is a violent burst of radio interference which may last for five minutes or five hours, and which stops as suddenly as it starts. The interference is concentrated in the vicinity of the pole and house but it persists when the house supply is turned off and signals tuned on a portable transistor receiver. A P.M.G. inspector has heard the noise and localised it, establishing that it is not apparent at any of the surrounding farms.

Those who have heard it have blamed it on salt on the S.E.C. insulators (the property is surrounded by sea, 3 miles away on 3 sides) or on shorts through the cable leads in the transformer. It has even been blamed on to shipping but this is not supported by the fact that the interference is apparently weather-conscious, being bad during dry summer months, very bad after light rain but not so bad after heavy rain.

This latter observation would be consistent with insulator problems but does not explain the abrupt start and stop of the noise. Our correspondent (F.C.) thinks that it has something to do with the method of reticulation. He says:

*"I think the house is surrounded by some kind of an electrical field. All the farms around me are on a single-wire system. The pole has three big earths going down into the ground and radiating outwards in three directions for about 40 feet."*

Our correspondent says that he could possibly take advantage of TV since he is well placed to receive the Gippsland channels 4 and 10—provided, of course, that the interference doesn't block that out also! However, he is not a lover of TV and has provided his own answer to the problem of good music:

*"About four years ago, I bought a stereo radiogram and, since then, have got together a collection of about 600 records, mainly 12-inch stereo albums. On top of that, I have got together about 200 600ft tapes of items recorded from a variety of sources."*

F.C. says that this has cost him a lot of money but he can listen to the kind of music he likes, any time he wants to.

And this, of course, is the very point we have been making for a long time. The more music lovers are denied the music they want, by interference, limited broadcast quality, program formats, or anything else, the more they will become self-sufficient in terms of their own disc and tape libraries.

J.B., formerly of Mansfield, Vic., is another reader who says he turned to his radiogram to meet his desire for good music, when he lived in a region poorly served by AM radio. He explains that Mansfield, with a population of about 5,000 in the town and surrounding districts, is very poorly served. The nearest A.B.C. stations are in Melbourne and the nearest commercial stations in Shepparton and Wangaratta, 80 and 65 miles away respectively. He goes on to say:

*"Reception in the day time is reasonable, save for power mains interference but, at night, reception becomes almost impossible,. Signals from all stations fade and distort continuously.*

*Complaints to the P.M.G. Department are a waste of time, as its officers frankly admit that Mansfield is one of the worst places in Australia for broadcast reception but add that the population is too small to warrant a local relay station.*

*"As a consequence most music lovers have turned to the hi-fi gram for their enjoyment of good music.*

*"This disregard shown by the P.M.G. Department for the legitimate needs of listeners have made them completely uninterested in radio broadcasting save for the morning news and a few daily sessions for the women folk. Thus I can endorse your comments that radio fills little more than a casual or service role."*

While one can well understand this correspondent's feelings about poor radio reception, comment is called for on his condemnation of the P.M.G. Department, as the body presumably responsible for his plight.

This department is largely responsible for providing and/or supervising the technical side of the radio broadcasting service. It operates a large number of transmitters, "polices" operation of the remainder, provides landline and similar services, collects licence fees for transmitters and receivers, concerns itself with interference problems, and so on.

But decisions about the number of broadcasting stations, their location and who shall have the licences are more the concern of the Australian Broadcasting Control Board. This board seeks to interpret community need, technical practicability, commercial practicability and the relevant policy of the Federal Parliament.

The decision to annex for other purposes the VHF FM band was taken at Parliamentary level, on the advice of the Australian Broadcasting Control Board but, so I gather, against the judgment of technical officers in the P.M.G. Department. But, with the decision taken, we are left in the situation where expansion of local broadcasting is limited as much as anything by the lack of available channels in the normal AM broadcast band.

And this is the way things are likely to remain until some decision is reached at Parliamentary level on the establishment of FM services in the only part of the spectrum which would appear to be available—up around 500MC.

Citizens or groups should by all means protest at what they consider inequitable treatment, but it is not much good picking on a poor, perspiring radio inspector or hurling misdirected abuse at a department. In most cases, your Federal Member is in a much better position to put your case.

At this point, one can introduce the next letter from a reader from New Zealand with the oft-repeated phrase "you think you've got troubles!"

He comments on our February editorial, "We Can Do Without Pirates," which takes on a special significance in the face of a recent news item about a proposed "pirate" radio station off the New Zealand coast. He writes:

*"I can well understand that, from an Australian point of view, the pirate broadcaster has no place in the scheme of things. Your Government has, for many years, pursued a liberal and enlightened policy of allowing private enterprise and State controlled broadcasting to operate side by side.*

*"The people of Australia have a choice of programs. So do the people of Canada, U.S.A. and the other Americas. As far as I know, there are no pirates in any of these countries.*

*"But in other parts of the world, the situation is different. There is only one broadcasting service, that controlled by the State. In providing an alternative program, the pirate broadcaster is providing a public service (assuming, of course, that it is not directed against normal law and order).*

*"Whether or not the pirate has legal status does not really enter into the matter.*

*"I should like you to consider Radio Luxemburg which, for many years has openly provided entertainment on a large scale for most of Europe. Is Radio Luxemburg a pirate? It is providing exactly the same sort of program in the same sort of circumstances as Radio Caroline and the other off-shore pirates.*

*"Personally, I hope that the activity of the pirates will move the Governments concerned to an enlightened twentieth-century policy on broadcasting and peaceful co-existence between State control and private enterprise." (G.P., Auckland, N.Z.)*

Well, there's a nice piece of Forum material.

Our February editorial was based on the need to maintain law or order in the radio spectrum in this part of the world. The shortage of frequencies in the AM broadcast band has already been referred to and one can only commend authorities in Australia and New Zealand for their efforts to systematise allocation of frequencies and minimise interference by control of location and power and the use of directional aerial arrays.

One or more pirate radio stations, grabbing frequencies on purely local considerations — or grabbing them at all for the matter — could upset much of this careful planning. The losers, in the ultimate, must be listeners themselves.

Yet, this correspondent from New Zealand, who certainly is not alone in his views, sees the proposed pirate station as a protest — allegedly the only kind of protest to which his Government will listen.

On this ground, he is prepared to say "good luck to them."

And at this point, we are up against the old, old problem of the end justifying the means—maybe!

To change the subject, a letter from A. B. (Springwood, N.S.W.) comments on an item from the May issue. I quote:

*"I may be one of the very few people in Australia who can comment on your Forum item on page 79 of your issue for May, 1966.*

*"Before coming to Australia, I was in charge of seismic exploration crews, both as a party manager and supervisor in the Sahara Desert and have faced similar problems with radio there.*

*"The main trouble there, as no doubt in Central Australia, is from dust creeping into all equipment, messing up relays, etc.; along with this is the extreme heat.*

*"Even world-renowned SSB sets can give trouble under these conditions. They cannot very well be made dust-proof, as heat dissipation problems would then make necessary an entirely different form of construction.*

*"AM equipment is inherently simpler, although it is not entirely fair of your correspondent to compare a small — and*

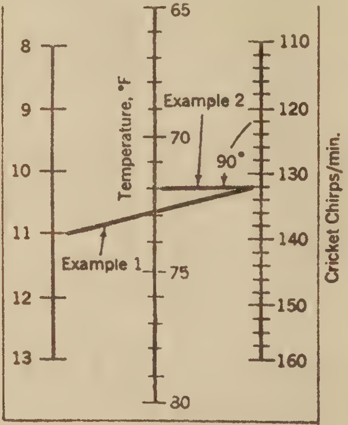
## Crickets, Fireflies Tell Temperature

*A reader (A.V.B.) from Merrylands, N.S.W., forwards a copy of two items from the correspondence pages of "Chemical and Engineering News." Apparently workers in this field have their moments of levity, as do their counterparts in the electronics industry.*

*Dear Sir:*

*Re the item "Crickets on the Infrascope" (C&EN, March 29, 1965, page 110, "News-scripts"):*

*Nature lovers have long known of the temperature-dependency of a cricket's chirping rate. We have now increased the accuracy of the temperature determination by this means by adding another great truth: The flashing rate of a firefly is also directly proportional to temperature. Hence by taking two observations of naturally occurring phenomena and averaging the results, anyone communing with nature can determine, if he should so desire, the prevailing atmospheric temperature with some precision.*



*The nomograph herewith will aid materially in this determination.*

*One merely has to count the number of cricket chirps and the firefly flashes per minute (for a single specimen of each species), connect the two values on the nomograph with a straight line, and read the temperature on the middle scale. If it is not possible to observe both species, and only one datum point is available, the nomograph can still be used by drawing a perpendicular line through the proper rate scale and the temperature scale.*

*For the analytically minded, the relationships involved are:*

$$T_1 = 0.25\ C + 39.0$$

$$T_2 = 2.32\ F + 48.1$$

*and* $T_{av} = 0.125\ C + 1.16\ F + 43.55.$

*Where T is in °F., C is the number of chirps per minute and F is the number of flashes per minute.*

*It is hoped that we have enhanced the present state of the art with this improved method of "accurately" determining temperature, although it would appear that manufacturers of more exotic (and expensive) instruments have nothing to fear, since much work has yet to be done to persuade crickets and fireflies to practice their marvelous art in pipelines, tanks, or chemical reactors.*

*J.G.L. (Princeton, N.J., U.S.A.)*

### More On Fireflies . . .

*R. T. Sanderson, of Arizona State University says that he has looked into the nomograph developed by J.G.L., to correlate temperature with cricket chirps and firefly flashes (C&EN, May 17, page 4). Mr Sanderson's aim was to check the range of applicability of the correlation. He did so by ". . . heating a firefly to 1,000 degrees C. At this temperature the flash rate must be extraordinarily rapid, for to all appearances the firefly gave forth a steady glow. When cooled to —190 degrees C., he didn't flash at all."*

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**(REFER PAGE 121, MARCH 66)**

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## FORUM — continued

*probably sealed — AM set with a more complicated SSB set.*

*"On the other hand, a 100W PEP SSB transceiver should not weigh 170lb and be as large as described. Also, using some sort of matching unit, there is no need to summon a technician each time such a set is installed. I feel that the design is an older type; a modern, and slightly modified unit should easily out perform it."*

Reading this letter, I had the feeling that the writer was as much concerned about defending the SSB mode as he was with the original complaint.

Granted, the unit referred to in our May issue was probably an obsolescent type and a modern unit would largely have obviated the problems of weight and setting up — both of them very relevant for an expedition in a desert situation.

But if the modern unit, small and efficient though it might be, is still oversensitive to dust, then the operator has merely exchanged a large unit that he can't rely on for a small unit that he can't rely on!

It seemed to me that, in the original letter, the correspondent's real concern was with the matter of reliability, which he proceeded to link (perhaps questionably) with the mode of operation.

The point that seems to emerge from all this is the sheer necessity of having equipment which is designed for the proposed environment. If the AM equipment available happened to be less sensitive to dust (by reason of its sealing or its mechanics) than the SSB equipment,

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then the AM equipment would be the more reliable.

But the reverse situation could conceivably arise.

One thing is certain: A piece of gear which operates fine in a "ham shack" or communications centre, may fail dismally if bumped around all day in a vehicle, or exposed either to dust or to tropical humidity.

To change the subject yet again, we reproduce herewith a letter from a reader, F.B., from Forestville, N.S.W. I suggest you read it at this stage.

# CIRCUIT SYMBOLS AND ECONOMY

*Dear Sir,*

*In your recent May issue you advised your readers of your intended change in semiconductor symbols in order to bring them into line with symbols most currently used in Britain and the U.S.A. You also hinted at the necessity to review your symbols from time to time to keep pace with increasingly frequent changes in "standards."*

*In my opinion, you have touched upon a subject to which, in the past, not nearly enough attention has been given but which becomes more and more important in the light of the ever faster development of the electronics industry.*

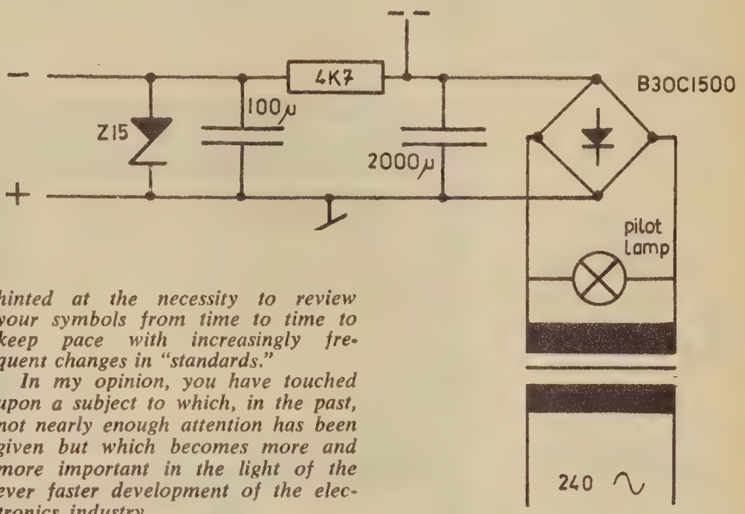
*In the past, the saying: "Any Standard is all right as long as it's a Standard" was quite acceptable, but in this age of rapid developments, overworked and understaffed drawing offices, manufacturers have to think twice before adopting any circuit symboling system.*

*Symbols, first of all, must be clear but, almost equally important, must be easy to draw. With regard to this second requirement, many current American and British symbols leave a lot to be desired. The drawing, and particularly the tracing, of solenoids is an agonisingly slow business and the "sawtooth" resistors require considerable attention.*

*In your symbol of a Zener diode, for instance, no less than three different line thicknesses are used and it takes quite some time to draw a signal lamp like the one depicted in the diagram on page 55 of your May issue.*

*The Standards gradually being adopted by the European electronics industry, in my opinion, are quite a step ahead in this regard. Spirals and sawtooth lines have been done away with and circles are becoming rare. Thus, a remarkable improvement in "drawing economy" has been achieved, with no reduction in readability.*

*As an example of this model approach to circuit drawing I am attaching a diagram of a power supply, with full-wave rectification, for a semiconductor circuit.*



*A gradual move towards similar standard symbols might well pay handsome dividends in the long run.*

*I would be interested in any comments by you, or possibly by other readers, on this subject.*

*(F.B.) Forestville, N.S.W.)*

As you will observe, F.B. comments on our change in semi-conductor symbols and then goes on to raise the whole vexed question of circuit symbol practice.

The thing that immediately strikes one about the letter is that F.B. puts his case predominantly from the viewpoint of drawing economy, on the apparent assumption that this is the major consideration.

It is an important consideration, to be sure; I say this against a background, years ago, of long sessions at the drawing board, doing things the hard way. I have vivid memories of T-squares, of drawing inductors with a compass, of a collection of lettering guides and pens of varying diameters, and of ruling pens with differently shaped tips and reference lines scribed on the knurled knob.

As I said—the hard way!

But ease of drawing isn't the only consideration. I am also mindful that circuit symbols pertaining to wireless-radio-electronics have served to date, as an effective kind of shorthand, in which the "pictorial" quality of the symbols has saved generations of people, concerned with them, from unnecessary feats of memory.

Even with all the variations, the order of recognition has been very high, such that most people have been able to make sense out of most circuits, irrespective of age or origin.

I should therefore suggest that drawing economy should be regarded not as a sole factor nor even as a dominant one, but rather one that must be considered alongside the "recognition" quality of symbols.

It is readily possible, for example, to contribute to drawing economy by omitting the outlines which have customarily enclosed valves and, more recently, transistors. I find personally, however, that this greatly reduces my ability to appraise the operation of a circuit.

Circuits, to date, have largely been grouped around active components and it is a tremendous asset to have these clearly distinguished, rather than have to sort them out from a maze of other lines and symbols and try to remember where they are. For the same reason, I find it helpful to have capacitors given some individuality, rather than be just another couple of lines, of the same thickness as all the rest.

This is put forward as a largely personal opinion but, if it is correct, it does lead to the question as to whether the time expended by one draftsman in preparing a circuit is more important than the time of the many people who have to read it.

Dominating the whole question is the matter of "standards," so called.

There is no eternal law for symbols, from which draftsman and engineers have strayed, like so many sinners.

Rather is it that each group—commercial, educational, national, etc. — have evolved their own practices within the aforementioned "pictorial" symbol concept, weighing their decisions according to factors as they saw them.

"Standardisation" emerges as and when majority groups manage to sink their differences and agree on common practice.

We changed our transistor symbols purely to conform to majority practice and not because we had any special regard for the "standard" way of doing things. In fact, there was much to be said for the validity of the system we discarded.

Relevant to the whole question of drawing economy, line thickness and such like is the fact that circuits for blockmaking and copying by reflected light need not be drawn by the classical and tedious method.

Our own draftsman never draws inductors or resistors, these days. He simply clips the required number of loops or zig-zags from a pre-printed sheet, pastes them on to the circuit, extends the lines to meet them and obliterates any sign of the join by a touch of white ink.

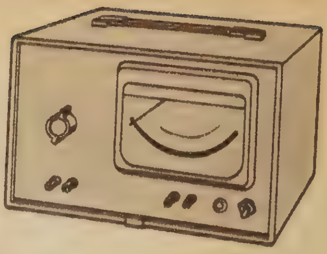
The same goes for valves, transistors, transformers, capacitors and a variety of other routine components. With such pre-printed stick-on symbols, it is possible to mix line thickness in the interest of pictorial clarity, to square the ends of broken lines and so on.

The type is also stuck on in the same way.

This has been the natural way for us to do things, as a printing house, but it happens to be the way in which printed wiring board patterns are coming to be laid out—with stick-on lines, blobs, circles and lettering.

The alternative labour-saving approach is, of course, in the use of lettering and symbol guides, which are now available in such array.

# Voltage Measurement



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Multipliers for up to
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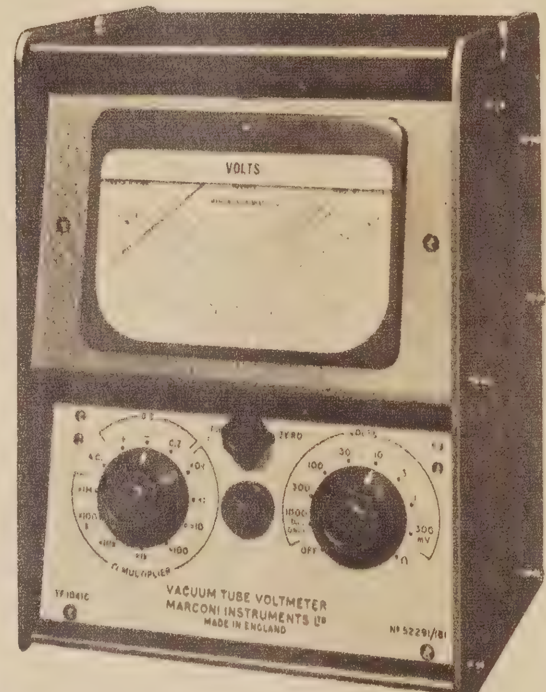

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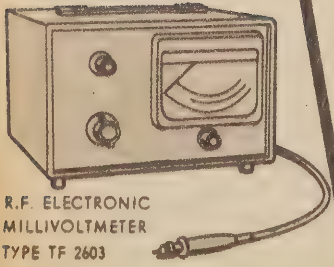

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# A GLOSSARY OF GERMAN TECHNICAL TERMS

The problem of deciphering a data sheet or circuit diagram printed in Geman language is a common one in Australia, where a considerable proportion of electronic equipment sold originates in Europe. The following is a list of some common expressions found in diagrams and literature.

| GERMAN | ENGLISH |
|---|---|
| Abschirmung | shield |
| Abschluss (or Abschluß) | termination |
| Abschwacher | attenuator |
| abtasten | record |
| Analisieren | analyser |
| Anordnung | arrangement |
| Anzeiger | indicator |
| Aufnahme | recording |
| Ausgang | output |
| Ausgangsleistung | output power |
| Ausgangsstufe | Output stage |
| Ausgleichen | Equalise |
| Ausgleichsimpuls | Equalising pulse |
| Austastpegel | Blanking level |
| Austastimpuls | Blanking pulse |
| Basis | base |
| Basisstrom | base current |
| Basisspannung | base voltage |
| Begrenzer | limiter stage |
| Bezeichnung | title, identification, description |
| Bildrohre | picture tube |
| Breite | width |
| Brucke | bridge |
| Brumm | hum |
| Buchse | socket |
| Dampfung | damping |
| Dampfungsfaktor | damping factor |
| Drossel | choke, coil, |
| Durchschaltung | interconnection |
| durchschalten | interconnect |
| einstellen, einstellt | operate, operates |
| Einheit | unit |
| Eingang | input |
| Empfanger | receiver |
| empfindlichkeit | sensitivity |
| Erde | earth |
| Ersatz | alternative, |
| Farbe | colour |
| Fassung | socket |
| Feder | spring |
| Feinsicherung | low current fuse |
| Fernsehempfanger | television receiver |
| fremd | external |
| flach | flat |
| Formung | shaper |
| Gebrauchsanweisung | operating manual, instructions |
| Gehause | case, housing |
| Gehause-Erde | chassis earth |
| Genauigkeit | accuracy |
| Gerausch | noise |
| Gestell | frame |
| Gestell-Erde | frame earth |
| Gleichrichter | rectifier, detector |
| Halbleiter | semi-conductor |
| Hall | echo |
| Halter | clamp |
| halten, haltet | hold, holds, clamps |
| Heissleiter (or Heißleiter) | thermistor |
| Heizfaden | filament |
| Heizleistung | heater power |
| Hersteller | manufacturer |
| Hochfrequenz | high frequency |
| Hochfrequenzlautsprecher | tweeter |
| Hochleistung | high power |
| Hochspannung | high tension |
| Impulsbildung | pulse generator |
| Impulsgeber | pulse stage |
| innerlich | internal |
| isolierte | insulated |
| Kanal | channel |
| Kapazitat | capacity |
| klein | small, miniature |
| Kollektorstrom | collector current |
| Kondensator | capacitor |
| Kopfhorer | headphones |
| Kuhlung | cooling |
| Kurzschluss | short circuit, closed circuit |
| laden, ladet | charge, charges |
| Ladungsgerat | charger (battery charger) |
| Langspielschallplatte | long-playing record |
| Lautsprecher | loudspeaker |
| Leistung | power, power unit |
| Leistungsfaktor | power factor |
| Leistungsverstarker | power amplifier |
| Leitung | line |
| Leitungsverstarker | line amplifier |
| links, linke | left |
| messen, messt | measure, measures gemessen= measured) |
| Meßschaltung | test point, |
| mischen, mischt | mix, mixes (note also gemischt= mixed) |
| Mutter | nut |
| Muttergenerator | master generator |
| Nachbildung | dummy |
| Netz | mains |
| Netzverzweigung | network |
| Netzvergleich | mains comparator |
| Niederfrequenz | low frequency |
| Norm | standard |
| Patrone | cartridge (for pick-up arm) |
| Pegel | level |
| Phasendiskriminator | phase discriminator |
| Punkt | point |
| rechts, rechte | right, to the right |
| regeln, regelt | adjust, adjusts (geregelt= adjusted) |
| Regler | regulator |
| Rille | groove |
| Rohr | valve (electronic) |
| Rohrenstift | valve pin |
| Ruckkupplung | feedback |
| Schall | sound |
| Schallplatte | gram. record |
| Schallplattenspieler | record player |
| Schallplattenwechsler | record changer |
| Schalter | switch |
| Schema | schematic |
| Scheibe | washer, disc |
| Schraube | screw |
| Schraubenzieher | screwdriver |
| Sender | transmitter |
| Sicherung | fuse |
| Stabil. Netzteil | stabilised power supply |
| Starthilfe | start auxiliary |
| Stecker | plug |
| Steuerquartz | crystal control |
| Steuerschalter | master switch |
| Steuersender | master oscillator |
| Stift | pin |
| Stufenschalter | step switch |
| Taststufe | keying stage |
| teilen, teilt | divide, divides (also reduces) |
| Teiler | splitter, divider |
| Tieftonlautsprecher | woofer |
| Tonarm | pickup-arm |
| Tonfrequenz | audio frequency |
| Trager | carrier |
| Ubertrager | transformer |
| Verdrahtungsplan | wiring diagram |
| Verhalten | behaviour |
| Verstarker | amplifier |
| Verzerrung | distortion |
| Verzogerung | delay |
| Vorverstarker | pre-amplifier |
| Wiedergabe | replay, playback |
| Widerstand | resistance, resistor |
| Zahler | counter |
| Zeitbasis | time base |
| Zerhacker | vibrator |
| Zubehorteile | accessories |

## COLOURS

| | | |
|---|---|---|
| 0 | Schwarz | black |
| 1 | Braun | brown |
| 2 | Rot | red |
| 3 | Orange | orange |
| 4 | Gelb | yellow |
| 5 | Grun | green |
| 6 | Blau | blue |
| 7 | Violett | violet |
| 8 | Grau | grey |
| 9 | Weiss (or Weiß) | white |

## NUMERALS

| | | | |
|---|---|---|---|
| 0 | Null | 6 | sechs |
| 1 | ein | 7 | sieben |
| 2 | zwei | 8 | acht |
| 3 | drei | 9 | neun |
| 4 | vier | 10 | zehn |
| 5 | funf | 100 | hundert |

**NOTES:** The word "the" has several forms in German, and may be encountered in any of the following forms: der, die, das, des, den or dem. In the same way, there are several forms of the indefinite article "a," which may appear as ein, eine, eins, einen or einem.

The Greek letter beta is used instead of "ss" where the two letters belong to the same syllable, as distinct from a mere juxtaposition of two syllables, of which the first ends in "s" and the second begins with the same letter.

All nouns, and other parts of speech used as proper nouns, begin with a capital in German. The tendency for forming of compound nouns should also be noted. If the separate parts are known, it is often possible to translate a compound expression. For example, Hochfrequenzlautsprecher is a compound made up of hoch (high), Frequenz (frequency) and Lautsprecher (loudspeaker). Thus the term translates as high frequency loudspeaker, or tweeter.

Some words, particularly verbs and adjectives, take different endings, according to the case and gender in the case of adjectives, and tense or person in the case of verbs. Thus the adjective "isolierte" (insulated) may appear as isoliert, isolierten, isoliertes, isoliertem, while the verb "fassen" can take the following forms: fasse, fasst, fasste, fassten.

Many words in German have an Umlaut over the vowel. The Umlaut consists of two dots over the vowel, and is used to show a change in pronunciation from the normal vowel sound. Because the Umlaut is not provided for in type used in English language publications, it has not been used in the above list.

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(11) Mode Selector
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(13) Power Switch
(14) Headphone Jack
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(16) L-channel Player Input
(17) L-channel Tuner Input
(18) L-channel AUX Input
(19) L-channel Recording Output
(20) L-channel Tape Monitor Input
(21) R-channel Tape Head Input
(22) R-channel Player Input
(23) R-channel Tuner Input
(24) R-channel AUX Input
(25) R-channel Recording Output
(26) R-channel Tape Monitor Input
(27) Ground Terminal
(28) "DIN" Jack for Tape Recorder
(29) L-channel Speaker Output Terminals and Jack
(30) R-channel Speaker Output Terminals and Jack
(31) AUX AC Outputs

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PHONO 3 mV.
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TREBLE 10 kc. ± 11db.
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+ 8db. at 10 kc.
EQUALISER: RIAA for phono • NAB for tape head
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WEIGHT: 17½ lbs.

**REVIEWED IN APRIL, 1966, ISSUE ELECTRONICS AUSTRALIA**

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# A READER BUILT IT!

***Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.***

During the past couple of months, we have received a lot of contributions for our "Reader Built It" page — more than we could possibly cope with at the rate of a page per month. So we've grouped a lot of them together, representing circuits, gadgets and ideas with which some of our younger readers — and perhaps others — have been experimenting in pursuit of electronics as a hobby.

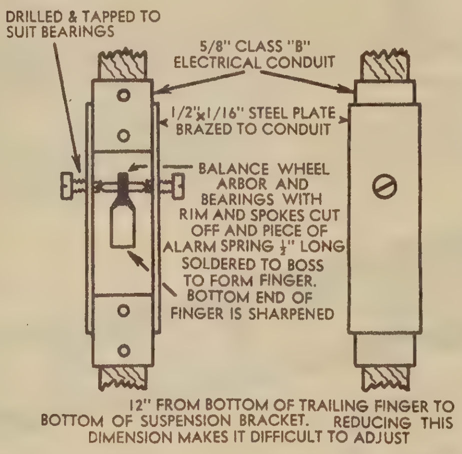
Prompted by the reprint, in our April 1966 edition, of the "Pendulum Type Electric Clock," C. W. Mann, 20 Fourth St., Leigh Creek, S.A., suggests minor improvements to the project.

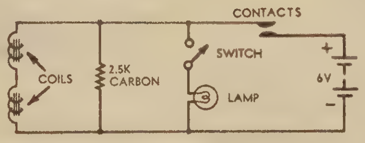
"I built my clock in 1947, from the original article, on the recommendation of friends who had successfully completed it. I have made some improvements which I shall now describe, the diagrams serving to illustrate points raised in the text.

"The improved trailer finger assembly is worth-while and does not twist the pendulum as did the original one. The contact spring is the governor spring from an old gramophone, the actual contacts coming from an old switch and soldered on. For a suspension spring I used a safety razor blade, it having a convenient diameter hole at either end to take a screw. Mine is still going strong after 19 years. I also made a heavier type suspension bracket of steel.

"When mounting the clock face mechanism make sure that the crutch rod fulcrum is in axial line with the suspension spring top clamp, otherwise the crutch rod will rub up and down the pendulum rod and cause it to make a scraping noise, being especially annoying at the 'dead o' night'.

"The modifications to the electrical circuit are very good, and are the best that I have discovered for lengthening the life of the contacts. The 2.5K carbon resistor prevents high voltages being generated at the moment of contact opening, due to collapse of magnetic field in the coils. Otherwise sparking across the contacts builds up a high resistance deposit on them and causes the clock to stop.


DRILLED & TAPPED TO SUIT BEARINGS
5/8" CLASS "B" ELECTRICAL CONDUIT
1/2"x1/16" STEEL PLATE BRAZED TO CONDUIT
BALANCE WHEEL ARBOR AND BEARINGS WITH RIM AND SPOKES CUT OFF AND PIECE OF ALARM SPRING ½" LONG SOLDERED TO BOSS TO FORM FINGER. BOTTOM END OF FINGER IS SHARPENED
12" FROM BOTTOM OF TRAILING FINGER TO BOTTOM OF SUSPENSION BRACKET. REDUCING THIS DIMENSION MAKES IT DIFFICULT TO ADJUST


CONTACTS
SWITCH
COILS
2.5K CARBON
LAMP
6V
+
−

*Top: Drawing of improved pendulum. Bottom: Electrical circuit of clock.*

"The switch and 6 volt torch globe are for setting up the electrical circuit for optimum operating conditions, as follows: Operate the pendulum weight by hand and arrange the system so that the contacts are opening as the leading edge of the armature meets the leading edge of the coil core. If the contacts do not break until beyond this point, a downward pull is exerted in the pendulum which is not desirable. Also, do not have the contacts make too far back as this connects the battery in circuit before it is really required, with a resultant waste of power and shortened life.

"With the circuit correctly adjusted, four standard torch cells have, on several occasions, lasted up to 15 months.

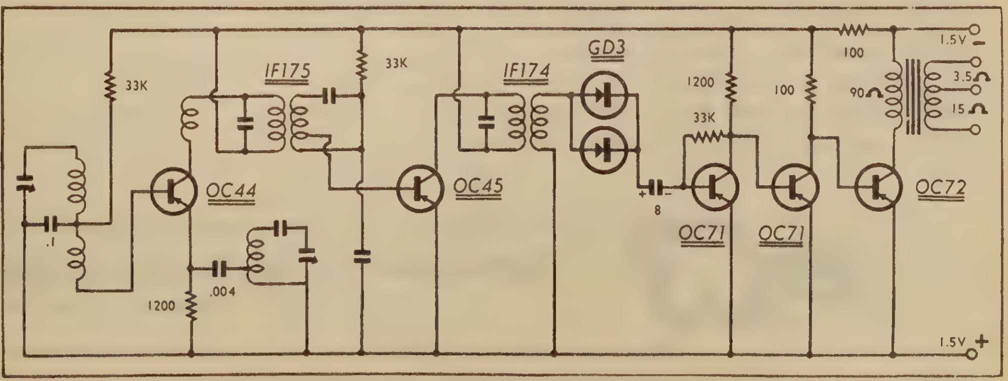
"The clock face figures are 1¼in high and the minute hand 4½in long. All are cut from sheet brass, mounted on 3-ply wood and polished. My cabinet is 6ft high, made of tulip oak and French polished, making a nice piece of furniture. I have fitted two dummy chains with weights to give it a more professional appearance. It is a good timekeeper and goes a month or more before any appreciable time error is noticed, this usually being no more than ½ minute.

"There are other details, too long for this letter, but which the individual constructor should be able to work out. However, the improved pendulum is a must."

## ECONOMY TRANSISTOR RECEIVER

The next contribution, a low cost five transistor broadcast receiver, comes from O. Andersen, 21 Lennox St., Rockhampton, Qld., and is an ideal project for beginners.

"The present high cost of components makes the home construction of radios scarcely an economic proposition. Therefore, I set out to design a transistorised


IF175
33K
33K
IF174
GD3
100
1.5V −
3.5Ω
90Ω
15Ω
1200
100
33K
OC44
OC45
8
OC71
OC71
OC72
.1
.004
1200
1.5V +

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"A glance at the circuit shows just how few components are required. To achieve this economy the set is supplied from one 1.5V torch cell, which removes the problem of stabilising the base voltages and allows direct coupling, thereby eliminating the usual resistors, capacitors and driver transformer. Four of the five transistors have their emitters earthed which eliminates the resistors and bypass capacitors usually used in this part of a circuit.

"Even the volume control potentiometer is omitted, directional characteristic of a ferroxcube rod aerial being used to vary the volume. If desired, some reduction in the volume of local stations can be achieved by slightly off-tuning.

"Should more output be required, a push-pull output stage could be added without much difficulty, and, for that matter, so could a further IF stage.

"The coil kit is the most expensive component. However, I used junk box parts on hand, the transistors being a bargain purchase from an interstate advertiser in your magazine.

"In using a GD3 diode it was found necessary to use two in parallel for optimum performance. Perhaps a single GD4, or similar type, would give better results.

"Its performance is good, and best use is made of the 40mW output by using a 5in speaker. The set may be built into the speaker housing, thus making a compact unit. Sensitivity and tone are comparable to a conventional six-transistor set, and, at low level, better than many employing push-pull output. The output is sufficient for normal room listening at a comfortable level."

## TELEVISION SOUND RECEIVER

Philip Johnson, 30, Selworthy Avenue, South Oakleigh S.E.13, Vic., submits a circuit diagram of a two valve VHF receiver capable of receiving the sound channel of television transmissions, and includes a suggested component layout with constructional data for a suitable receiving aerial.

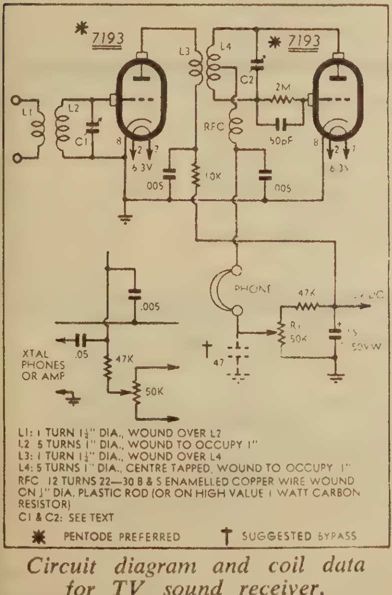
Our correspondent states that this receiver will be of most interest to those who live in areas served either by Channel 0, 1 or 2, which it receives extremely well. It is not designed to receive channels higher than these.

The writer continues: "The detector is a standard super-regenerative type and is preceded by a simple RF stage. Type 7193 (2C22) valves, which are available for 25c. are used in both these stages.

"R1 is the super-regeneration control, and is set to the point where super-regeneration occurs, which is identified by a loud hiss.

"C1 and C2 are 3-30pF trimmers with shafts soldered to the adjusting screws, and tune L2 and L4 respectively. The coils should be made out of fairly heavy wire, 14-20 B. and S. being suitable.

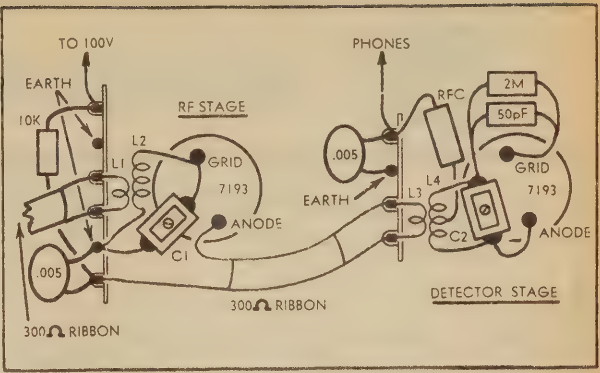
"Although the aerial is tuned to Channel 2, it gives equally good reception on Channel O."

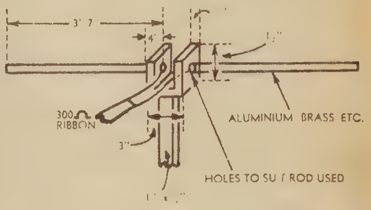


L1: 1 TURN 1½" DIA., WOUND OVER L2
L2 5 TURNS 1" DIA., WOUND TO OCCUPY 1"
L3: 1 TURN 1½" DIA., WOUND OVER L4
L4: 5 TURNS 1" DIA., CENTRE TAPPED, WOUND TO OCCUPY 1"
RFC 12 TURNS 22—30 B & S ENAMELLED COPPER WIRE WOUND ON ½" DIA. PLASTIC ROD (OR ON HIGH VALUE 1 WATT CARBON RESISTOR)
C1 & C2: SEE TEXT

✱ PENTODE PREFERRED † SUGGESTED BYPASS

*Circuit diagram and coil data for TV sound receiver.*





*TOP. Suggested under-chassis layout for TV sound receiver. BOTTOM: Dimensions and construction of a suitable aerial.*

## SUBSTITUTION TEST BOX

From C. G. Shulkins, Thomas Street, Moruya, N.S.W., we received the following circuit diagram and description of a substitution test box.

"This substitution test box, which I have constructed and found to be very speedy and effective for experimental and service work, should be a great asset to mechanics and experimenters. It has several advantages over many commercial types on the market, as follows:

Switch selection of 10 resistors and capacitors.

Switch selection of 100 resistors and capacitors in series and parallel.

Resistance values range from 50 ohms 5 watt to 5 megohms 1 watt.

Capacitance values range from 100pF to 25uF at 600 volts working.

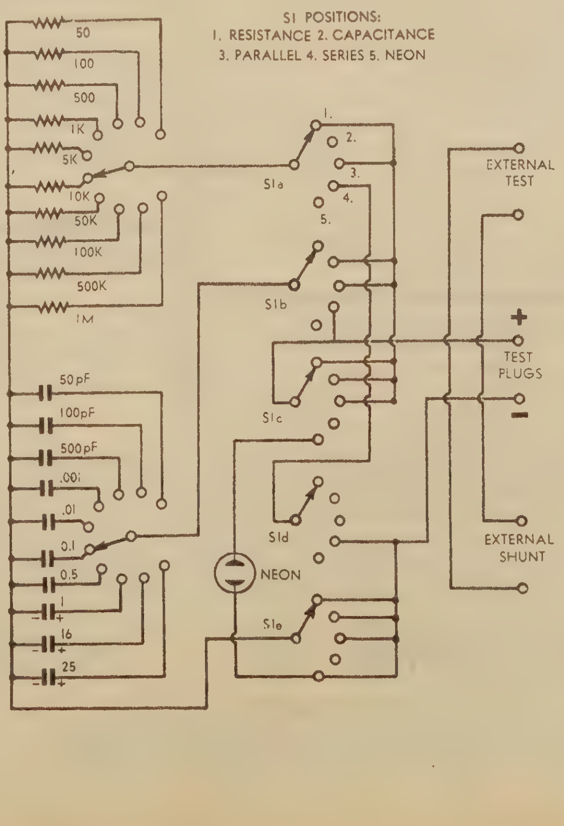
Neon indicator for continuity.

"All components can be individually selected by switching, and are automatically connected to a common pair of terminals, thereby obviating the necessity of moving the leads to select values.

"Extra terminals for connection of components into circuit. With this facility, a component can be connected across the 'Ext. Shunt' terminals, and with the test leads in the 'Ext. Test' position, can be connected into a circuit.

"As with any test equipment, only best quality, and preferably high stability, components should be used for accuracy. Capacitors should all be of the high voltage rating type.

The values of the resistors and capacitors used may be altered to suit individual requirements, and by the use of either a 12 or 14 position switch (if readily available), a greater range could be obtained. The whole unit may be conveniently housed



*Substitution test box circuit diagram.*

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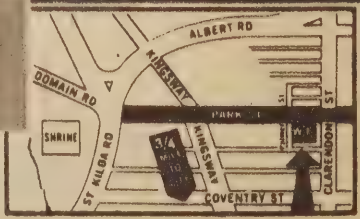

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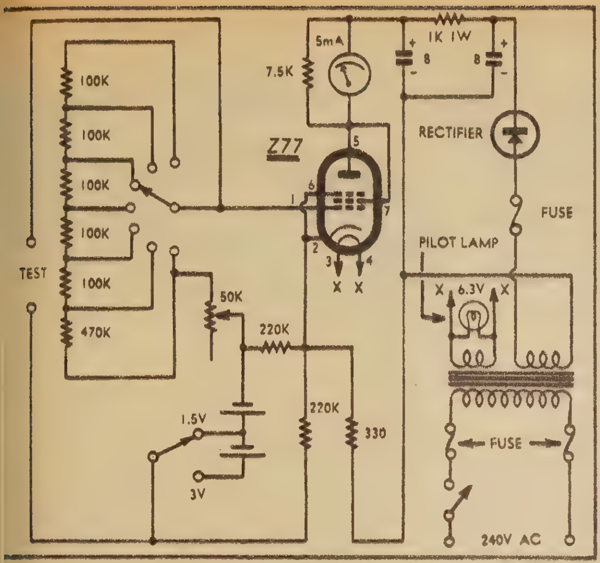


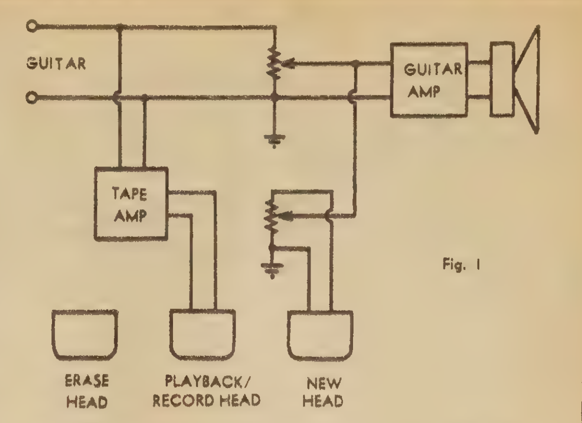


Fig. 1

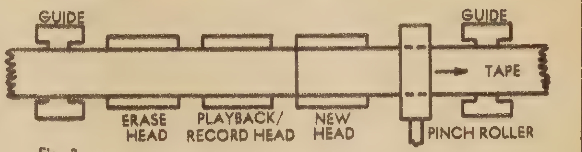


Fig. 2

*TOP LEFT: Circuit diagram of electronic lie detector.*

*TOP RIGHT: Figure 1, block diagram of reverb. system. Figure 2, tape recorder head arrangement.*

*BOTTOM: Crystal set circuit and coil diagrams.*

in a box measuring approximately 6in x 9in."

## REVERB. FROM TAPE RECORDER

Following an article on reverberation in our April edition, Master Gary Kurzer, 3 Parsley Road, Vaucluse, N.S.W., was prompted to forward us this method of achieving echo and reverberation using a domestic tape recorder.

"I don't know if the idea or set-up is new, but it fully satisfies its purpose as used in conjunction with my electric guitar.

"I have a Sony 102 'Tapecorder' that originally had only erase and playback/record heads. Recently I fitted an extra playback head (a cheap one being quite good enough), and two output sockets, one of which is connected in parallel with the input, and the other directly to he new head. These outputs are then fed into separate amplifiers. It will be found that this arrangement gives a pleasing echo effect and will suit most requirements.

"Two methods of supplying tape to he heads were open to me:

(1) Use a full spool

or, and the preferable one,

(2) Placing two empty spools on the nachine and running a continuous loop f tape through the heads and around hem. Alternatively, it is possible to urchase continuous tapes.

"I used a recording speed of 7½ ips, ut if a tape recorder with a speed of 5 ips is used, the new head can be laced outside the head assembly.

"To achieve a continuous echo, as a riend of mine did quite successfully, ne experimenter can try feedback nethods."

## ELECTRONIC LIE DETECTOR

Sent in by W. Vandersant, 139 Ayers venue, Edwardstown, S.A., this novelty em could be a popular device to have t a party.

"Here is the circuit diagram of a lie etector that I thought would be an iteresting project for the junior radio xperimenter, which, even though it is imple and inexpensive to build, can ve many hours of pleasure and amusement.

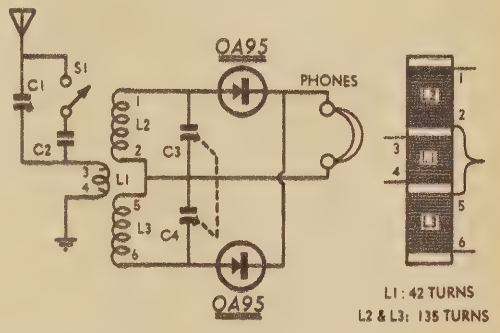
"An interesting experiment is when boy kisses a girl, each holding one of e test prods. People perspire in varying degrees, therefore, a very shy couple would have the highest reading.

"However, I am sure that this device will create many uses for itself."

## USE FOR OLD TUNING CAPACITOR

We spotted this circuit of a crystal set in Wireless Institute of Australia Youth Radio Scheme Newsletter No. 12, of February, 1966, having been contributed to that publication by John Thyrd.

"It looks like the answer on how to build a crystal set using a two-gang tuning capacitor from an old radio receiver. This is a full-wave rectification type of circuit, so make sure that all the coil windings are in the same direction, otherwise the signals will cancel. In some instances, C1, C2 and S1 may be omitted, but will probably result in a decrease in signal strength and selectivity.

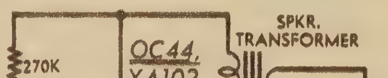


"The coils, using 34 swg, or the nearest gauge on hand, are close wound on a former 1in in diameter and approximately 4½in long, with a space of ¼in between windings. Information regarding the number of turns per coil is given in the diagram."

## ONE-TRANSISTOR TRANSMITTER

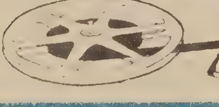
Also from a recent issue of a Youth Radio Scheme newsletter, from the New South Wales Division, comes this circuit for a simple telephony transmitter for laboratory demonstrations.

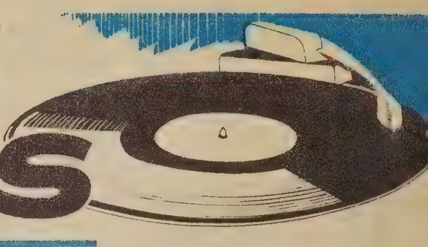
As will be seen, this is a transistorised equivalent of a simple type of plate modulated transmitter. The newsletter points out that simple short-range transmitters, tunable in the broadcast band, can be made from educational kit sets, such as those supplied by Philips Electrical or Edu-electronics. By using a 1000KC crystal with the circuit shown here, the transmitter would be tunable on any broadcast set but, to prevent the range exceeding the legal limit (confined to laboratory building), only one 1.5V cell should be used.



*Circuit of simple 3.5MC telephony transmitter.*

# AUDIO TOPICS





## The PWM amplifier controversy . . .

Perhaps the "hottest" subject currently discussed in audio circles is that of pulse-width-modulation or "PWM" amplifiers. Are they, as supporters claim, markedly superior to conventional "linear" amplifiers? Many would disagree, suggesting that while fine in theory they turn out in practice to be virtually "a harder way of doing an inferior job."

### by Jamieson Rowe

In this article the author will attempt to clarify the controversy. This will be done in the main by reference to basic theory, manufacturers' claims, and the evaluations of various researchers and reviewers; however, mention will also be made of the results of tests which were recently carried out on some sample units.

For the benefit of readers who are as yet either unfamiliar or only vaguely familiar with pulse-width modulation and its application to the field of audio, it will no doubt be worthwhile to preface the main discussion with a brief introduction and review.

By definition, in the field of communications the term "modulation" is used to imply the encoding of information upon a signal which then becomes the "carrier" of the information. As electrical signals have a number of characteristics capable of being varied, there are quite a number of ways in which the encoding can take place: variation of amplitude, phase, frequency, or waveform—or any of the many possible permutations and combinations of these. Thus we have "AM" or amplitude modulation, "FM" or frequency modulation, and so on.

Within the methods of modulation which employ waveform encoding is pulse-width modulation or "PWM." Although perhaps less widely known than the familiar FM and almost ubiquitous AM, it has in fact been used for some time to provide reliable multi-channel communication in such fields as telemetry and radio-telegraphy. In common with other pulse modulation systems it offers a high degree of immunity from noise interference.

As early as 1930 it was realised that PWM might be applied with advantage to the field of audio amplification. In 1931, a British patent covering this idea was issued to a B. D. Bedford. However, it was found that there were quite a few problems involved, particularly where waveform fidelity was concerned, and the idea tended to drift into technological limbo.

Some ten years ago this situation changed with the growth of control engineering, and the need to provide high-power amplifiers to drive servo motors and actuators from small error and control signals. As in many such cases waveform is unimportant—or can be made so—it was found that PWM provided an efficient and quite practical answer.

However, although PWM thus made its (now firmly established) entry into "audio" frequency amplification, it was still regarded as being of little use where waveform accuracy was required. It would seem that the first serious attempt to apply the principle to what might be called "hi-fi" audio was made quite recently, in an article by D. R. Birt in the February, 1963, issue of the journal **Wireless World** entitled "Modulated Pulse AF Amplifiers."

Although this article aroused considerable interest it was not until late
1964 that PWM really made much i
pression in serious audio circles. P
bably the event which precipitated t
was the release by the British fi
Sinclair Radionics Ltd. of their "X-1
integrated power amplifier-preamp, w
a claimed output of 10 watts RMS, h
monic distortion less than 0.1 per ce
frequency response 5-20,000cps, dam
ing factor greater than 100 for a 15-oh
speaker, and efficiency of 95 per ce
All this on a printed board 6in x 3
and with no heat sinks.

In May, 1965, Sinclair announced
second PWM amplifier, the "X-20," a
vertised as the big brother of the fi
model; it is rated at 15W RMS conti
ous into an 8-ohm load, again with
THD of less than 0.1 per cent, a
sponse of 20-25,000cps plus/minus 1d
a signal/noise ratio of better than 70
and an efficiency of 95 per cent.

But more of this later . . .

Over the last year or two there ha
been quite a few articles published
overseas journals: for example, in Ap
1965, G. F. Turnbull and J. M. Tow
end of Manchester University publish
an article in **Wireless World** describin
"Feedback Pulse Width Modula
Audio Amplifier." In the July, Aug

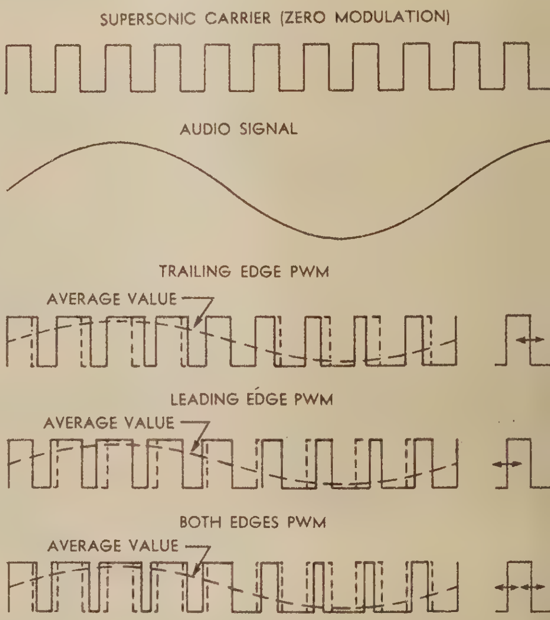


Fig. 1

*A diagram illustrating the three types of PWM. The majority of PWM amplifiers employ the "both edges" system, although the other two systems have theoretical advantages where low distortion is essential.*

and September, 1965, issues of **Hi-Fi News** writers L. N. Hulley and K. Jackson published a series of three articles headed simply "PWM Amplifiers."

For those keen to do so, these articles can be read with profit.

As the name implies, PWM uses as a carrier signal a train of pulses; usually these have a repetition frequency of 50-100KC, and in the absence of the modulating information (or when the amplitude of this information is instantaneously at zero) the pulse-width-to-pulse-spacing or "mark-space" ratio of the pulses is unity. As shown in figure 1, this means that under zero-modulation conditions the carrier is virtually a square wave.

The modulating information, comprising the audio signals to be amplified, is arranged so that its amplitude variations control the **width** of the carrier pulses. In other words, the mark-space ratio of the supersonic carrier is made to vary above and below its basic value of unity, in synchronism with the audio signals.

As may be seen this can actually be done in one of three ways. The audio can be used to vary the position of the pulse trailing edges, the pulse leading edges or both edges at once. All three produce a somewhat similar result, namely a signal of constant amplitude whose **average value varies in synchronism with the audio modulation.** This follows because during the positive half-cycles of audio the average value of the pulses becomes positive, while during the negative half-cycles the average value becomes negative.

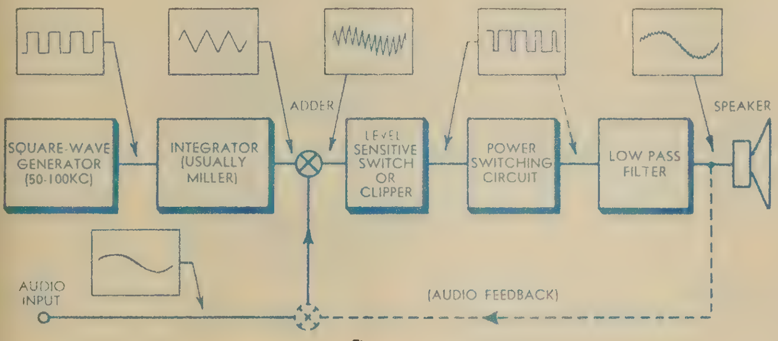

SQUARE-WAVE GENERATOR (50-100KC)
INTEGRATOR (USUALLY MILLER)
ADDER
LEVEL SENSITIVE SWITCH OR CLIPPER
POWER SWITCHING CIRCUIT
LOW PASS FILTER
SPEAKER
AUDIO INPUT
(AUDIO FEEDBACK)

Fig. 2

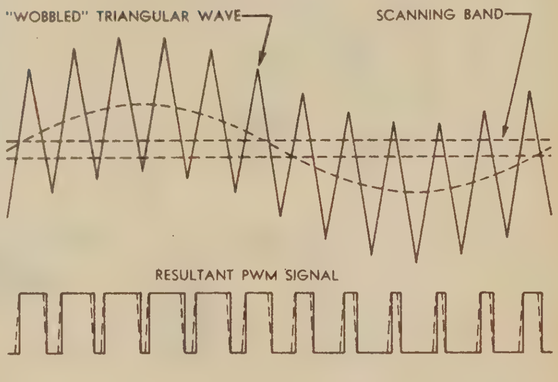


Fig. 3

*Above, the block diagram of a typical "both edges" PWM audio amplifier, showing ideal waveforms. At right: how the wobbled triangular wave is scanned to produce the PWM signal.*

Of the three ways of achieving PWM the "both edges" system is the most popular, usually being the easiest to achieve with practical circuits. For this reason the following brief description will deal only with a "both edges" PWM amplifier. However, amplifiers using the other two methods are, in general, somewhat similar.

Figure 2 shows the basic arrangement used by the majority of PWM amplifiers, and can be used to illustrate most of the principles involved.

The supersonic carrier signal is generated in square-wave form, usually by a multivibrator circuit running at 50-100KC. The output from this generator is then fed to an integrator, which ideally changes the square waves into an accurate triangular wave. In most cases the integration is performed by a feedback or Miller circuit, in order to achieve reasonable linearity. (With leading or trailing-edge PWM, the square wave is converted not into a triangular wave, but into a sawtooth.)

The triangular output waveform of the integrator is then added to the audio input signal, usually in a simple resistive mixing circuit. This produces a composite signal in which the supersonic triangular wave is virtually "wobbled" up and down by the audio signal.

To convert this composite signal into the required width-modulated pulses it may be treated in alternative ways; both effectively "scan" the central portion of the wobbled triangular wave as shown in figure 3.

The cheaper way is to use a biased-diode or transistor clipper circuit. However, as this retains at least a vestige of the sloping edges of the triangular wave (shown dashed) it is preferable to adopt the other method, wherein a level-sensitive switch such as a Schmitt trigger is used to produce a more accurate rectangular equivalent of the scanned segments.

Incidentally, when drawing the diagram of figure 3 our draughtsman drew the attention of the author to the fact that for completely distortionless modulation with clipper-type scanning and "both edges" PWM, the "scanning slit" would have to be infinitely narrow. Unless the "slit" is infinitely narrow there will be unequal average modulation for positive and negative audio half waves, giving second-harmonic distortion. However, we will have a closer look at distortion a little later on . . .

The first theoretical advantage of PWM should now become clear. Because the width-modulated pulses appearing at the output of the clipper or level-sensitive switch are only two-valued, linear circuits are not required for power amplification; simple "on-off" **power switching circuitry** may be used. Where transistors are concerned this is a big point, as in general transistors are somewhat better suited to switching than they are to linear amplification.

After power amplification has occurred the final step is recovery of the original audio information — i.e., demodulation. Basically, this is done by low-pass filtering, relying on the fact noted earlier that the average value of the PWM signal varies in synchronism with the encoded audio information. By filtering out the "pulse" components in the PWM signal, this average energy of the signal is left — and if all is according to plan, this will be an amplified replica of the original audio input.

In the cheaper PWM amplifiers, most of this low-pass filtering is left to the speaker itself. The theory here is that the speaker cone is incapable of moving at the supersonic rate, but will simply follow the variations in average value; its mechanical and electrical parameters constitute the required low-pass filter.

This involves a number of compromises and problems, however, as will be discussed shortly. Hence the more "serious" designs employ a separate electrical filter to perform at least a major part of the filtering. This is in fact a necessity where it is intended to apply audio negative feedback, as shown dashed in figure 2. And audio negative feedback is virtually essential in practice, if reasonable quality is to be achieved.

It should be noted that the type of PWM shown in figure 2 is normally called an "open-loop" amplifier — even if it is fitted with conventional audio negative feedback as mentioned above. The term "open-loop" is used to distinguish this type from a less common variety of PWM amplifier, in which the supersonic carrier is generated by the switching circuitry itself by means of an additional overall feedback loop. Such "closed-loop" PWM amplifiers tend to be smaller and less costly, but tend to be considerably more difficult to stabilise. Further details of this type of amplifier are to be found in the Turnbull-Townsend article mentioned earlier.

Before examining the claims made for and against PWM amplifiers brief mention should be made about measurement difficulties. This matter will be discussed further later on in connection with the practical tests, but should be mentioned here to allow better appreciation of the problems involved.

Because the output of a PWM amplifier has a large supersonic component it proves quite difficult to make the usual

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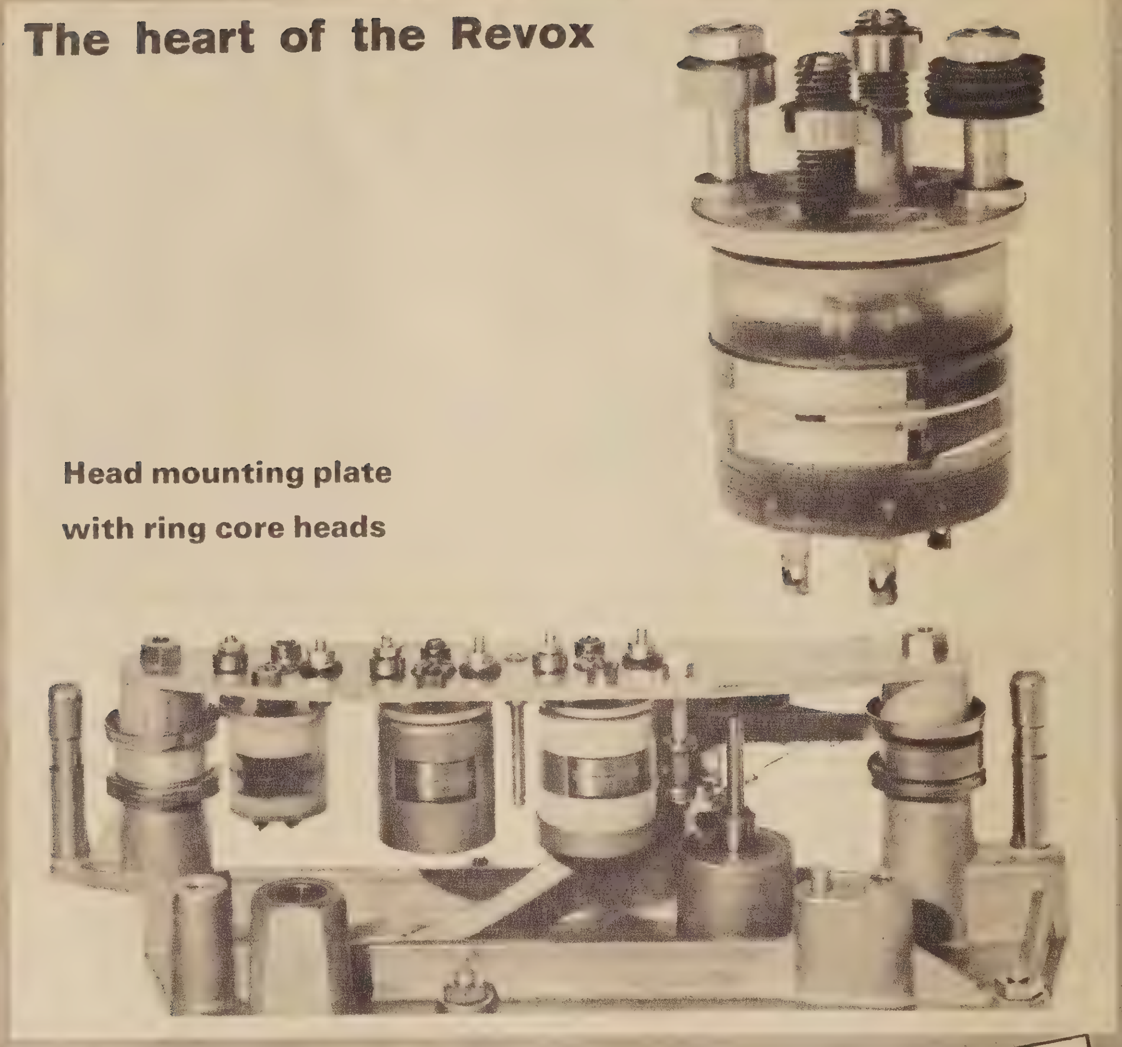

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measurements of power output, distortion, signal/noise ratio, and even frequency response. Without elaborate filters the supersonic component tends to overload instruments and confuse measurements. Yet the use of special filters can also give misleading results due to abnormal amplifier loading. Evaluation of PWM amplifiers is thus far from simple.

Let us now examine the various claims made for and against these amplifiers.

Perhaps the most common is that they are **highly efficient;** for example, Sinclair claim efficiencies in excess of 95 per cent. This claim is made both in terms of lower current drain for a given output power, and also along the lines that for a given power output a PWM amplifier will be smaller and cheaper than a conventional type — because it supposedly can employ smaller output transistors and does not require elaborate heat-sinks.

Theoretically, this claim is fairly easily justified. Whereas in a normal linear amplifier the power transistors are the main source of power loss — as heat dissipation — in a PWM circuit these components theoretically spend all their time alternately in two low-dissipation states: they are either saturated ("bottomed") or cut off. Thus output stage efficiency should be very high, minimising battery drain for a given order of power output and allowing the use of small transistors without elaborate heat-sinks, as claimed.

In practice, however, extremely high efficiencies are hard to achieve. The first problem is that practical transistors are not able to switch from "on" to "off" (or vice-versa) in zero time. They require a definite switching time, and during the actual switching they dissipate power.

The longer the switching time the lower the actual efficiency of the output stage. And note that switching time is also a function of the **driving waveform** —a non-rectangular waveform will increase switching time, hence the desirability of using a level-sensitive switch instead of a simple clipper circuit.

In general, if efficiency is to be markedly better than conventional amplifiers it proves necessary to employ fairly costly high-frequency transistors—and not just in the output stage.

This of course tends to nullify the claim of economy; although it may be noted that manufacturers usually try to suggest the use of HF transistors is a "bonus" employed to ensure exceptional frequency response. In fact, the connection between the frequency response of the transistors and that of the resultant PWM amplifier is a second-order one.

Along with the problem with the output transistors themselves there is a further problem associated with the output low-pass filter. Practical filters are not only inefficient in themselves, tending to waste power as heat and radiation losses, but they also tend to influence the switching speed of the output transistors by presenting the latter with a reactive load component.

A further practical problem with PWM amplifier efficiency is that, due to the additional pulse generation and integration circuitry, the power requirements of the amplifier "front end" are no longer as small as they are with conventional amplifiers. With a typical PWM design the drain of this section of the amplifier can add quite appreciably to that of the output stage.

In short, high efficiency is by no means easily achieved in practice. Although output stage efficiency can be kept fairly high using HF output transistors and carefully designed filters, it is difficult to obtain practical overall efficiencies in excess of 65 per cent. This is very little more than that of a well-designed conventional class-B amplifier.

**Low distortion** is perhaps the next most common claim made about PWM amplifiers. This is usually based on the idea that the amplification is not dependent upon the linearity of the transfer characteristic of the driver and output transistors.

This is approximately true — as far as it goes. However it is in fact only half the story because, while the linearity of the amplifier is not to a first approximation influenced by linearity of the amplifier transistors (which simply function as switches) it certainly IS influenced by the **linearity of the triangular wave** used in the modulation process. The amplifier linearity is, in fact, a direct function of this wave form.

And in practice it is just as hard to generate a linear triangular wave as it is to achieve linear amplification; PWM simply substitutes one linearity problem for another. With transistors the problem of producing a linear triangular wave at 50-100KC is, if anything, harder than achieving linear audio amplification.

Also, as mentioned earlier, there is a potential source of distortion in the "scanning" process used to derive the PWM signal from the wobbled triangular wave. For zero second-harmonic distortion from this source with "both edges" PWM, the scanning slit (governed by the hysteresis of the clipper) should be infinitely narrow. And this is not possible in practice.

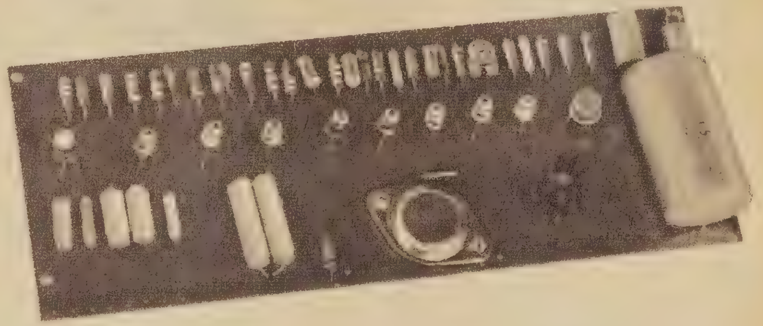
**It should be noted that this "scanning distortion" is only possible with "both edges" PWM; the other two systems are thus preferable from the point of view of distortion.**

A further complication with regard to distortion is that, as with all practical modulation processes, PWM produces spurious and unwanted modulation products. Thus, there is a basic tendency for the amplifier to produce heterodyne "whistles."

Unless the supersonic carrier is raised to about 100KC it is very difficult to prevent these heterodynes becoming audible — particularly on momentary overload peaks. Although normally unnoticed on a conventional amplifier these thus tend to become painfully obvious with a PWM amplifier. Yet raising the carrier frequency demands the use of costly HF transistors.

A third claim commonly made for PWM amplifiers is that they have an extremely low output impedance, resulting in **excellent transient response** from the loudspeaker. **I.e.,** that the amplifiers have an extremely high "damping factor."

At first appearance this seems a valid claim, as the output transistors spend half their time in the saturated state, where they represent a very low impedance; and with a push-pull output stage this suggests that the loudspeaker will always "look" back into at least one saturated transistor.



*The manufacturer of this "X-20" amplifier, Sinclair Radionics Ltd., of Cambridge, England, claims it to be the "most advanced hi-fi amplifier in the world." As part of the preparation for this article the author tested three sample X-20 units, with results as described.*

But as before there is a catch: as soon as as the low-pass filter is connected between the transistors and the speaker this argument no longer holds. In principle, the filter isolates the speaker from the transistors, transforming the latter into an effective audio generator of somewhat indeterminate source impedance. Just what the audio output impedance of the amplifier will be will depend upon the filter, the output transistors, the switching waveform and so on.

The three claims discussed so far represent the main advantages claimed of PWM amplifiers; and as we have seen all three are rather hard to substantiate in practice. However the "knockers" of PWM go further than this, and point out that PWM has definite **disadvantages** quite apart from simply failing to realise its theoretical potential.

The most common of these claims is that PWM amplifiers produce audio and RF interference due to radiation. This is a result of the not-inconsiderable levels of supersonic **square-wave** signal present both in the amplifier itself and in the associated wiring — including the leads to the speakers . . .

PWM amplifiers proponents meet this situation by suggesting that the amplifier be well shielded (though sometimes on the grounds that the amplifiers are themselves embarrassingly "sensitive" to interference!). However, the critics rightly point to the problem of shielding speaker leads, speakers, etc.

Emphasising the order of this problem, even PWM supporters seem to be at something of a loss where radio tuners are concerned. It would appear that no amount of shielding proves sufficient to

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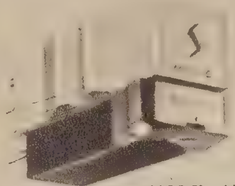

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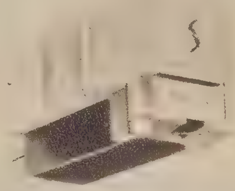

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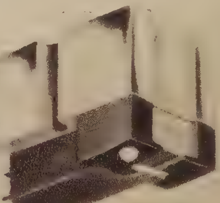

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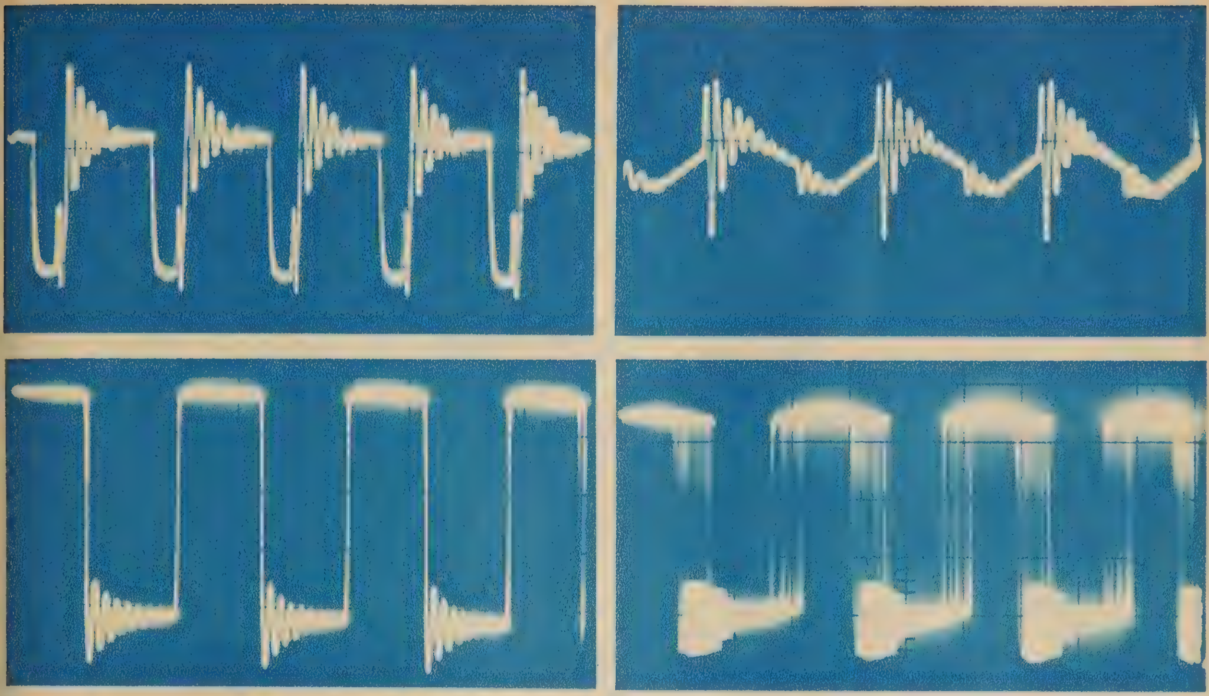

*Four representative oscillograms taken from one of the sample X-20 amplifiers tested by the author. At upper left is the output from the pulse generator (approx. 66KC); upper right shows this signal after integration and prior to mixing with the audio input. At lower left is the PWM signal at the output of the power switching stage, prior to filtering and with zero audio modulation; lower right is the same signal with a moderate degree of audio modulation.*

prevent trouble where it is desired to connect a tuner to a PWM amplifier in conventional fashion; only elaborate earthing and bypassing techniques can rescue the situation, and then not in an entirely satisfactory fashion. This is not hard to understand when one realises that a 50KC square-wave has harmonic components to **at least** 500KC.

A further claim with regard to the radiation from PWM amplifiers is that they tend to mutually interfere when two are connected together for stereo reproduction.

Another of the criticisms made of PWM amplifiers is that they have marked tendencies towards thermal runaway. Critics point out that the leakage current of transistors rises markedly when they are operated above their upper corner frequency (the frequency at which the current gain has fallen by 3dB), and that this causes heat rise. If there are no heat-sinks used, or these are insufficient, thermal runaway can occur very rapidly in view of the high-frequency energy available.

In fact, quite large heat-sinks appear to be required for satisfactory thermal stability in PWM amplifiers. Part of the problem appears to be that loudspeakers differ considerably in their effective impedance at the supersonic carrier frequency, some speakers causing quite high voltages to be reflected back to the output transistors.

As a general rule it proves very desirable not only to employ heat-sinks, but also to use in the output stage the more costly silicon power transistors in place of the common germanium type.

A further criticism made of PWM amplifiers is that there is a strong risk of speaker damage due to the considerable level of supersonic carrier applied to the voice coil. Although the impedance of typical voice-coils tends to be rather high at 50-100KC, resulting in only slight current flow, there would certainly seem to me to be a possibility that, with some speakers, the current flow may be sufficient to cause overheating and perhaps burnout.

Allied with this is the matter of maintaining a unity mark/space ratio under quiescent conditions. Any unbalance moves the voice coil away from centre, greatly increasing the risk of second harmonic distortion.

From the foregoing it is difficult to allow oneself to become very enthusiastic about PWM amplifiers. Certainly it seems unlikely that they will supersede conventional amplifiers — at least in the foreseeable future. In fact, the author finds it hard not to agree with writers Hulley and Jackson, when they conclude thus:

**"At present the only places where a future can be envisaged is in PA systems where high output power without low distortion—permitting a low switching frequency — is required, and recourse to expensive silicon transistors can be justified. Also, perhaps, in instances like tape recording where the generation of oscillations is required as an auxiliary function. Though in the future good transistors may become quite cheap, with the semi-conductors and techniques that are at present available linear amplifiers can be built which are more stable, both thermally and electrically, use less components and give a better performance than PWM types."**

Incidentally it should be noted that Hulley and Jackson are far from open to the charge of prejudgment or theoretical partisanship. On the contrary; the above quoted conclusion is reached only after a thoughful and open-minded discussion of both theoretical and practical design problems. And in fact the very article from which the quotation comes gives details of two quite practical PWM amplifier designs which were built up as part of their investigations.

To conclude this discussion, as mentioned earlier, mention must be made of tests which the author was recently able to carry out on some sample PWM amplifiers. The amplifiers were in fact Sinclair X-20 units sent to our laboratory for evaluation.

In all, three of the units were received and examined; the second and third samples being supplied by the local agents when it appeared that the first unit was faulty. However, from the performance of the second and third units received it may be doubted that the first had a specific fault.

Before discussing the performance of these units a few general matters should perhaps be mentioned as being apropos. The first is in connection with the measuring problem outlined earlier.

Apart from using a CRO to observe waveforms at various points in the circuit (see oscillograms), we found it quite pointless to connect measuring instruments to the units. There is so much supersonic signal around that the readings obtained have no meaning; in any case, the circuitry is quite sensitive to external loading.

In an effort to evolve a satisfactory method of measuring electrical power output and frequency response, we considered the use of an additional sharp-cutoff low-pass filter. However, the idea was dropped as there would be difficulty in ensuring the correct reflected load on the amplifier; apart from this the external filter would waste power.

The final procedure we adopted was to our mind the fairest and most practical: we simply fed the amplifiers into a speaker and compared them, aurally and with a microphone monitor system, with a conventional amplifier fed into an

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identical speaker. Among other things this allowed reasonably accurate estimation of output power and distortion.

The second matter which may be mentioned is in connection with the literature accompanying the amplifiers. This consists both of material from the manufacturer and supplementary data from the Australian agents.

As overseas advertising had led us to expect, the manufacturer's little booklet was glowing in its claims. However, the circuit diagram given revealed that the design could hardly be regarded as highly ambitious. Diode clipping is used to convert the wobbled "triangular" wave (the oscillogram explains the inverted commas), rather than the more preferable regenerative level-detector circuit; the "low-pass filter" is simply a small RF choke; and there is no attempt at audio negative feedback, despite the obvious shortcomings of the triangular waveform.

There is an interesting statement on page 9 of the booklet: "Magnetic pickups may be connected directly to the input, between terminals 2 and 6. No equalisation will normally be necessary, as most magnetic pickups are self-equalising when fed into a low impedance."

In fact, most hi-fi equipment designers appear to think otherwise as evidenced by their additional efforts to achieve proper RIAA compensation.

Another statement, on the last page, suggests the desirability of shielding: "The X-20 is very sensitive and can easily pick up and amplify mains hum and radio signals unless the proper precautions are taken to avoid such interference. It is advisable to mount the amplifier in a metal box . . ."

The literature accompanying the manufacturer's booklet makes another interesting statement: "Amplifier must not be used into highly inductive or capacitive load, i.e., crossover network. As serious distortion occurs." (To the best of my knowledge, a well-designed and properly terminated crossover network presents to the amplifier a load closer to a pure resistance than the majority of single speakers . . .)

In addition the most recent-looking of the accompanying sheets gives setting-up information not mentioned in the booklet, together with a warning that the supply voltage should not exceed 33 volts "unregulated" or 28 volts "regulated." (The booklet quotes values of up to 45V unregulated and 40V unregulated for 15-ohm loads, and gives no hint of the degree of regulation which would serve as a criterion.)

To mention the third general matter briefly: the following "average" results were obtained with slight deviations from all three amplifiers. They were taken with a single speaker connected to the output in each case, with power supplied from an unregulated 32V supply (just to be safe!). The supplementary setting-up procedure was carried out as per instructions. Our results are as follows:

POWER OUTPUT (sine wave): Using the comparision technique mentioned, most staff members recruited as listeners rated the "undistorted" power output on 1KC sine wave as not much greater than about 0.5W RMS. There is a certain amount of uncertainty here, as even at 0.5W there was audible distortion with all three units. One might be able to get the claimed 12W output, but the general consensus of opinion was that the distortion at this level would be quite high.

FREQUENCY RESPONSE: This seems fairly reasonable, although most listeners were agreed that the bass end sounded nothing like the claimed -1dB at 20cps. The treble end proved quite fascinating, in that a slow frequency glide revealed a number of quite audible heterodynes, as happens in some tape recorders where bias and signal overtones interact.

DISTORTION (sine-wave): As mentioned above, audible distortion was present in all units at 0.5W output — and it is generally held that distortion must be about 2-3 per cent to become audible. As output rose above 0.5W the distortion was heard both to increase and to change in quality in a rather strange fashion. One can only guess at the effective audio output waveform.

MUSIC TEST: Connecting a high-quality magnetic pickup of popular make to the suggested terminals produced surprisingly reasonable reproduction; although some listeners found the sound "harsh" and felt they could hear a type of modulation noise. (I am one of this group, and I would deny that auto-suggestion was the sole cause.) All concerned found it surprising that the reproduction sounds as good as it does, however. Despite the manufacturer's claim to the contrary, magnetic pickup self-equalisation was obvious in its absence—as might be expected.

Perhaps a partial explanation of the apparent conflict between the sine-wave and music tests is that the system distortion may be largely composed of **even-order** harmonics. While quite obvious on sine-wave, these would tend to harmonise with program material to become largely unnoticed.

HETERODYNES: As mentioned above, these were quite in evidence above about 7-8KC. A slow frequency glide revealed them as a series of programless "radio stations" scattered over the upper audio spectrum. No attempt was made to operate two units together stereo-fashion to test for mutual interference as this would have overloaded the power supply being used.

DAMPING FACTOR: Under the circumstances, there seemed to be little point in measuring this.

RADIATION: Tests with a portable radio showed that there was appreciable radiation from the amplifiers themselves, speaker lines, speakers, and the mains wiring nearby. We were not able conveniently to connect a tuner to the amplifier to ascertain the problems which this might involve. The portable radio showed harmonics right to the top of the broadcast band.

Incidentally, in common with a certain number of conventional transistor amplifiers, the X-20 has input and output "earths" which differ in DC potential and must not be connected together. This will tend to complicate any shielding arrangements adopted to reduce radiation.

NOISE: Electrical S/N measurements were not attempted. However listening tests showed the noise level to be fairly high.

There you have it, then. The essential facts about PWM amplifiers, and a frank report of our experience with samples of the well-known Sinclair units. I have tried to be as objective and as fair as possible. Readers should draw their own conclusions. ■

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# Classical reviews

By JULIAN RUSSELL

## Magnificent Berlioz "Requiem"

**BERLIOZ — Requiem. Philadelphia Orchestra, Temple University Choirs and Cesare Valetti (tenor) conducted by Eugene Ormandy. CBS Stereo (two discs). S2BR220017.**

When Berlioz' Requiem was first performed in Paris, in 1837, the composer demanded 500 performers of the Ministry of the Interior, which had commissioned the work. He had to make do with 450, which included a large orchestra, four brass bands, 16 timpani and a vast chorus. The performance was given in the Chapel of St. Louis, at the Invalides, where the composer arranged his unprecedented forces on either side of the sanctuary with, to quote him, "the various groups of instruments of the orchestra . . . tolerably widely separated, especially the four brass bands introduced in the Tuba Mirum, each of which occupied a corner of the entire orchestra and chorus."

Just what numbers were actually used in the recording under review is not disclosed by CBS . . . A sentence on the box which contains the two discs reads: "A thrilling sound spectacular magnificently scored for gigantic orchestras, four brass ensembles and 250 voices." At a guess, about 400 performers must have been under Ormandy's direction when the recording was made.

Now, it must be apparent that the actual sound produced by such a body as this, spread over a great deal of space, can only be approximately reproduced by two speakers placed from 6ft to 8ft apart. Yet, despite the magnitude of their problems, CBS's engineers have still managed to convey some idea of the vastness of the work in this recording. The sound, in fact, is at times quite electrifying in its amplitude and spread.

An important point to remember is that, though Berlioz insisted on such a vast force, he exercised wonderful restraint in using all of them together only rarely in the Requiem. Eight of the movements are normally scored. Only in the overwhelming Tuba Mirum, the Lachrimosa and the Rex Tremendae does he demand the full volume capable of being delivered by his performers.

CBS have, in these three movements, provided a magnificent acoustic that goes far to reproduce in one's sitting-room the effect sought by Berlioz at the original performance. The separation of the four brass bands placed at four corners of the orchestra and chorus is spectacularly effective. Yet clarity has been maintained in even the most fully scored passages. In only one spot does the illusion fail—in the Dies Irae, where the volume of sound has already risen to such a pitch of intensity that the crash of four tamtams and 10 pairs of cymbals that mark its climax can add nothing more to the physical effect. Indeed, I am not sure that they are even there.

But this is only a quibble, for throughout the long work, the quality of the sound, the balance between the various departments and the superb discipline exercised by Ormandy in their combination is beyond praise. And I am not selecting just the more fully scored parts of the work for this praise. The more delicate passages receive the same scrupulous attention in a work that tempts one to judge its excellence on its more massive effects. Berlioz' genius for orchestration was never more evident than in the delicate chords for high flutes and low trombones, quoted in every textbook on orchestration that I have ever read, with nothing between, which make the Hostias unique. Here they emerge with absolute clarity and sensitivity of balance.

The work itself is one of the finest in the vast literature of liturgical music, noble without pomposity, reverent without ever being sanctimonious, and moving in beauty. And it is amazing to recall that, such were the terms of Berlioz' commission, he had to dash it off in little more than three months in such a fever of inspiration that he had, on the side, to devise a method of musical shorthand to cope with the rush of ideas that inspired him.

This fact would never be guessed when listening to the Requiem. Its superb workmanship betrays not the slightest evidence of haste. As Cecil Gray pointed out in the early 1930s in his "History Of Music": "Even without this knowledge (that the work was composed in so short a time), the impression (it) makes in performance is that it has been conceived and executed in one single, unflagging volcanic burst of creative inspiration."

There are many quite enlightened musicians who regard Berlioz as a great orchestra innovator, but little else. While admitting his ingenuity in the treatment of rhythms, they disparage his value as a melodist. If ever a composition were able to rebut such a slander, it is the Requiem. It abounds in melodies, some meltingly beautiful in their small dimensions, others uplifting in their nobility. Robert Lawrence, in his notes which accompany the set, speaks only the truth when he writes: "We have heard enough of his (Berlioz') talent as an orchestrator. It is time, with the Requiem, to rank him among the great composing masters."

It would be unreasonable to expect, in a work of such magnitude, a performance perfect in every detail. But Ormandy, in this recording, comes as close to perfection as any other recorded performance I have so far heard. His orchestra plays splendidly throughout. The soloist, Cesare Valetti, sings lyrically, at the same time displaying an impressive appreciation of liturgical drama. And the purity of his diction should be noted by any student — or teacher — of singing.

The chorus is not always so completely successful. True they sing expressively most of the time, especially in the quieter reaches of the score, and their entrances are always cleanly made. But there are moments when their intonation becomes momentarily uncertain, and the sopranos especially show how difficult it is for any but French singers to maintain the long line of a Berlioz legato.

But such was my delight and total involvement in the performance offered here that I feel ungracious to mention even this small shortcoming. It gives you, in your sitting-room, a very real idea of the Requiem's august dimensions, its aesthetic merits never swamped by mere noise making, and, what is perhaps more important still, brings within reach of those unable ever to hear a live performance of its imperishable beauties, a means of enjoying them at will.

* * *

**ELGAR — The Dream Of Gerontius. Janet Baker (contralto), Richard Lewis (tenor), Kim Borg (bass), combined Halle Choir and Sheffield Philharmonic Chorus and the Ambrosian Singers, with the Halle Orchestra, conducted by Sir John Barbirolli. HMV Stereo ASD648/9.**

It is now just on 11 years since the famous Sargent performance of this fine oratorio was recorded and during that time I have spent many an enjoyable hour listening to it. This new reading is fine—I wouldn't be without it—but it in no way puts its earlier rival out of court. Even Sargent's most vigorous detractors would never think of denying that he is unquestionably one of the finest oratorio conductors on the English scene for many, many years and that he has a special affinity for the music of Elgar.

One of the glories to be enjoyed in his now-aging set is in the control he exercised on the ensembles, especially in his handling of the choir's entrances and in his treatment of passages that could continue to be deeply reverent without deteriorating into sanctimoniousness.

Barbirolli is, of course, no less gifted in this way, but the difference in their temperaments is deeply scored on their interpretations of this work. An opportunity for comparison comes very early —in the Prelude. Sargent was content to move the music along steadily up to the point where the voices enter. Barbirolli, on the other hand, breaks it up, Parsifal-wise, allots more weight to incidental small climaxes and might be charged with making it sound more rhetorical. Neither Sargent's nor Barbirolli's readings lack reverence, and that I think Barbirolli's makes a more moving preface to what has to follow is purely a personal preference.

The Sargent set was amazingly well engineered for its era. But even if the most recent of techniques had been used in its making, I doubt if the string tone of Sargent's Liverpool Philharmonic could ever have acquired the lustre of the Halle's, as heard here, nor Sargent's brass the splendid cutting edge of Barbirolli's.

Another indubitable point in favour of the new set is the natural sound of the Chorus of Demons, which, for once, does not impress as quite so ridiculous as usual. And to listen to only a few bars of this will demonstrate the excellence of the new choir's diction.

Richard Lewis was better under Sargent than he is here, though even here his performance of a role with which he has long been identified is admirable. He is now, of course, 11 years older than when he recorded the earlier performance, but I do not think his voice has deteriorated to the extent that this performance might imply. A more likely explanation is the fact that he was suffering from a cold during the recording sessions of the new set. And even on the strength of this performance, it is difficult to imagine anyone who might sing the role with the same passionate identification as Lewis.

Undoubtedly the finest account of the role of the Guardian Angel I have ever heard, either recorded or live, is Janet Baker's. Her delivery is unfailingly pure in every bar, her phrasing a constant delight, and her diction exemplary. A perfect performance of a lovely part. Kim Borg is nowhere nearly as successful. He has, of course, a fine bass, but sounds anomalously alien in accent and interpretation in this very English work.

Despite the manifest virtues of the Sargent set, I would, if I had to make a choice, pick the new one. And that decision would not be based on the more recent engineering of the latter. Sargent's reading is still grandly satisfying. But to me Barbirolli's is to be preferred, chiefly on account of the richer detail revealed in the scoring, the quality of the recorded tone of the orchestra, and the simple fact that despite differences in interpretation which might be questioned now that Sargent's reading has been accepted as definitive, Barbirolli's comes closer to the spirit of Cardinal Newman's text.

* * *

**OFFENBACH—Tales of Hoffman (complete opera). Nicolai Gedda (Hoffmann); Gianna d'Angelo (Olympia); Elisabeth Schwarzkopf (Giulietta); Victoria de los Angeles (Antonia); Jean-Christophe Benoit (Nicklausse); Nikola Guiselev (Lindorf); George London (Coppelius); Ernest Blanc (Dapertutto); Michel Senechal (Spalanzani); Jean-Pierre Laffage (Schlemil). Rene Duclos Choir and Paris Conservatoire Orchestra conducted by Andre Cluytens. H.M.V. Stereo SAN154/6.**

Taking it all round, this version is disappointingly unrewarding in terms of the promise offered by such an all-star cast. In the first place, the fact must be faced that more often than not non-French artists seldom sound altogether comfortable in this type of operetta, despite the fact that this particular one was written by a German, though, of course, a German who had, during many years residence in Paris, come to be more French than the French.

In the first place there is Elisabeth Schwarzkopf, her voice as creamy as ever but her style immutably Viennese. Her French accent, too, almost caricatures the language she is using. While on

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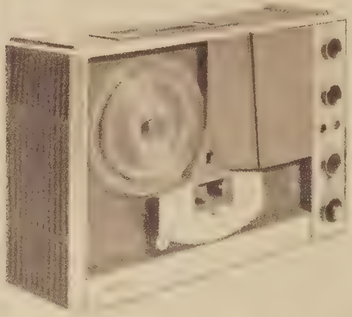

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the subject of accents, George London also finds difficulty in using this alien tongue. He is efficient enough in the demon-king goings-on of Coppelius but is unattractive vocally in this important role.

The usually enchanting Victoria de los Angeles seems sadly out of form as Antonia. She has not yet learned to control the long French legatos that occur so frequently in her music and, sad to relate, strays from the pitch here and there. Of the three important women's roles, I prefer Gianna d'Angelo's ("Olympia"), who might miss the clockwork-like delivery called for in her song, but still sounds more at home in this music than the other two.

Among the men, there are two fine performances—Ernest Blanc, a truly French Dapertutto, and Nicolai Gedda ("Hoffman"), who, despite his Italian extraction, has overcome all the problems associated with the delivery of this very French music, including the use of an enviable French accent. Jacques Loreau also makes a contribution worthy of mention in the small part of Franz.

Cluytens' direction is not without its inspiring moments, but in terms of the old Beecham recording, he drives rather than rides the music. The engineering of this new set is a great improvement on the earlier ones, but I think a better performance is bound to turn up before very long.

★ ★ ★

**ANSERMET CONDUCTS CHABRIER —Espana; Suite Pastorale; Marche Joyeuse; Danse Slave and Fete Polonaise from "Le Roi Malgre Lui." Orchestra of the Swiss Romande conducted by Ernest Ansermet. Decca Stereo SXL6168.**

**ANSERMET CONDUCTS DEBUSSY —La Mer; Khamma; Rhapsody for Clarinet and Orchestra. Orchestra of the Swiss Romande (solo clarinet, Robert Gugholz) conducted by Ernest Ansermet. Decca Stereo SXL6167.**

Anyone who remembers Beecham's performances, live and recorded, of Chabrier's Espana, must have delighted in the infectious high spirits engendered by his vivid, if not particularly subtle reading. Beecham never stopped short of vulgarity if he thought the occasion suitable, and I still recall with pleasure the rasping, outdoors tone he coaxed from his trombones in their famous solo passage near the middle of the work. It suggested all the coarse glitter of a Spanish urban scene under a glaring summer sun.

This is not the sort of playing you will hear under Ansermet. His manner is much more restrained and, despite Beecham's baronetcy, more gentlemanly. In fact it comes close to being a little pedantic at times. Technically the Swiss Romande players are irreproachable. And all observe scrupulously, as Chabrier is reputed to have insisted, the composer's tempo and expression markings. But having established a tempo Ansermet seems reluctant to change it and develops a pendulum-like monotony in rhythms Beecham took the liberty of making much more elastic.

The same might be said of the Suite Pastorale, which, though offering much o be admired in the way of sensitive nuancing, still sounds just a little prosaic. Sous les Bois is altogether enchanting in the clarity of its thought, playing and recording. Its polyphonic structure is beautifully stranded so that the many diverse lines are easily followed by the ear without the aid of a score. And the murmuring bass line — which always recalls to me the cellos' part in Micaela's first aria in Carmen, though quite unlike it in every way—is continuingly enchanting.

FALLING LEAVES

The Danse Slave as given here is exhilarating rhythmically and taken at a brisk pace that might, with profit, have been employed elsewhere on this always otherwise well-played recital. And I have never heard a more enjoyable performance of the Fete Polonaise with its many changes of rhythms, from Mazurka to waltz and back again, to keep the mind and ear constantly refreshed.

Debussy's Khamma is new to me, as it will probably be to many other listeners however comprehensive their knowledge of the composer's oeuvre. It was a commission by the dancer Maud Allen who specialised in the mildly erotic choreography thought to be very daring during the period she was in vogue—the late Edwardian. One of her more extroverted exploits was seen in Sunday private performances of the Dance of the Seven Veils in Oscar Wilde's Salome —the original play version, not the Strauss opera.

Debussy started off in Khamma with great enthusiasm but eventually lost interest in it to the extent of commissioning another composer, albeit a good one, Kochlin, some of whose music might with profit be revived today, to complete the orchestration. This he did in a manner altogether consistent with Debussy's style.

Some of Khamma's themes are commonplace when compared to those typical of Debussy in his other works, but he makes some interesting harmonic innovations, described by him in a letter as "the latest discoveries in the chemistry of harmony." Ironically, these show a strong influence of those in Stravinsky's "Firebird," a work he had dismissed with some hauteur at its first performance a very few years earlier. Not surprisingly, the workmanship displays craftsmanship of the very highest order and, as a curiosity, the ballet, described by Debussy as a "Legende Dansee," should intrigue many Debussy lovers to whom it will be novel. They will find some of the themes closely approaching banality, but others that are quite beautiful.

The Rhapsody for Clarinet and Orchestra will be more familiar and is rarely enough played to be welcome in recorded form. Here it is brilliantly delivered by the clarinettist, Robert Gugholz, with an accompaniment perfectly attuned, in its smooth cantabiles and sharply accented staccatos, to the soloist's demands.

"La Mer" must face strong competition from versions on other labels, my favourite of which is George Szell's. The Swiss Romande play it with commendable sensitivity and a fine sense of climax. But despite Decca's superb engineering, I missed some of the fine details that emerges so clearly in the Szell recording, and the wonderful precision that must be the despair of any other orchestra to imitate.

★ ★ ★

**J. S. BACH—Flute Sonatas in B Minor (BWV 1030); A Major (BWV 1032); and E Minor (BWV 1034). Elaine Shaffer (flute), George Malcolm (harpsichord), and Ambrose Gauntlett (viola da gamba). HMV Stereo OASD 633.**

The quality of the sound in this gracious recording is excellent and the playing of the artists of matching beauty. None of the three belongs to that school convinced that the only way to play Bach is to maintain rigid tempi and unvarying dynamics throughout. For instance, rubatos are used in this disc to perhaps a greater extent than is usual today, but they are always in character, never sentimentalise the text, and, importantly, give the very accomplished flautist time to breathe without destroying Bach's flowing melodic line.

George Malcolm uses a fragile-toned harpsichord that blends beautifully with the timbres produced by his colleagues, a far cry from the jangling instruments often heard nowadays that, to me, sound like freshly tuned honky-tonk pianos. The viola da gamba makes its own contribution without fuss and always in complete rapport with the other two artists in these eminently pleasing sonatas.

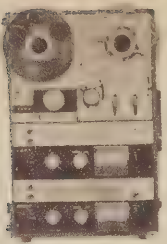
By the way, the fact that this disc is marked Volume 1 suggests that more of these sonatas are to come. I doubt if these will be as attractive as those on offer here. There is some doubt about the authenticity of the others which display neither the charm nor the exquisite craftsmanship of the three under review.

## *Recommended*

**Wagner—Tristan and Isolda.** Love Duet from Act 2. Birgit Nilsson (Isolda); Fritz Uhl (Tristan); Regina Resnik (Brangane); Tom Krause (Kurvenal). The Vienna Philharmonic Orchestra conducted by Georg Solti. Decca Stereo SXL6178.

**Handel—Concerti Grossi,** Op. 6, Nos. 7 in B Flat; 8 in C Minor; 9 in F Major and 11 in A Major. Yehudi Menuhin and the Bath Festival Chamber Orchestra. Soloists: Robert Masters (violin); Derek Simpson (cello); Kinloch Anderson (harpsichord). World Record Club Stereo ST/4057.

**Ansermet Conducts Berlioz—**Overtures: Le Carnival Romain; Beatrice et Benedict; Le Corsaire; Benvenuto Cellini. Music from "Le Damnation de Faust" —Danse des Sylphes and Minuet des Follets; Marche Hongroise. Decca Stereo SXL6165.



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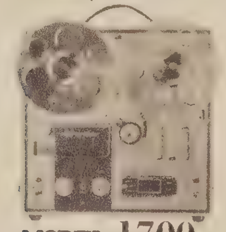

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# DOCUMENTARY RECORDS

## Reviewed by Ellis Blain

**DOROTHY STICKNEY: "IN A LOVELY LIGHT." A dramatisation of the poems and letters of Edna St. Vincent Millay. VANGUARD VRS 9201-2.**

Undoubtedly, Edna St. Vincent Millay is best known to the world at large for the four lines which were first quoted, if my memory serves, in that universally enjoyed anthology "The Weekend Book":

"My candle burns at both ends,
It will not last the night;
But ah, my foes and oh, my friends,
It gives a lovely light."

In a sense, these lines do her a disservice for, telling as they are, there is an immaturity to them which is totally inconsistent with the majority of her work.

Edna St. Vincent Millay is not only an American phenomenon, but a twentieth century writer of peculiar distinction and, often enough, passionate appeal to an audience which ranges from the popular to the discriminating. Not only did she compose a vast amount of poetry, some of it of exceptional quality, but she also wrote three verse plays and the libretto for an opera with music by Deems Taylor.

In addition, she was a capable actress and her weekly radio broadcasts of readings, mostly from her own works, during the 1930s were quality innovations in their day. The daughter of a nurse in the sea coast town of Camden, Maine, Edna was educated at Vassar and spent a number of years working in Greenwich Village. She was a Pulitzer Prize winner.

In 1964, 14 years after Edna died, American actress Dorothy Stickney opened at the Hudson Theatre in New York with the dramatisation of her poems and letters contained on these two records. "A Lovely Light" received exceptional reviews from the critics of which this quote from Books Atkinson of the "New York Times" is typical:

"An extraordinary theatre experience in every way . . . "A Lovely Light" is tender and beautiful. Dorothy Stickney is aglow with wonder."

Of the recording, I can say only that it fulfils the expectations aroused by the enthusiasm of the critics at the actual performance. For anyone already familiar with the unique attractions of Edna St. Vincent Millay's work, it will be an indispensable anthology. At the same time, it cannot fail to convert any but the most rabid opponent, if not fully to a respect for the intrinsic quality of her writing, at least to the warmth, beauty and depth of feeling with which it is supercharged.

* * *

**ARTHUR MILLER READING from "THE CRUCIBLE" and "DEATH OF A SALESMAN." SPOKEN ARTS 704.**

Miller is so well known both as a writer and as a personality that no lengthy analysis of this record is necessary. What he has to say in his introductory talk about these two of his best-known plays is well worth hearing but, once heard, will not often be referred to again, at least on the record. His readings of excerpts, while interesting and, in their way, unique, are but curiosities. They are more likely to be repeated, although they cannot in any way take the place of recordings of the works in toto.

One point made by the author bears quoting: "One may have made a trip to the Amazon and dazzle the laity with the mention of it, while the important point is really that one met a man or woman in the airport just before taking off who said something to set a story or a play in motion. If I have had a life at all worth mentioning, it is in my plays."

* * *

**BOOKS AND THE BAD LIFE by KENNETH ALLAN ROBINSON. SPOKEN ARTS 834.**

With the current education crisis in Australia, this record offers a remarkable example of that all too rare and quite inestimable quality that goes to make up the great teacher.

Professor Robinson was Professor Emeritus in English at Dartmouth College in the U.S.A. until his death in 1961. To have heard him lecture to his class is considered to have been both an unforgettable experience and a literary inspiration. His great friend and lifelong admirer, Cudworth Flint, vividly describes the effect of such a lecture upon his audience:

"Times, places, persons, events engulf them; but the times condense into a mood; the places coalesce into a vision; the persons emerge in their form and circumstance as they lived; and the events become a story woven of suspense, with glints here and there — sparingly — of pathos, and more frequently hues of hilarity. All too soon, the hour comes to an end. As the students disperse, they realise that 'learning more' would be an inadequate summary of what the hour just past has meant to them. They have lived more; some increment of vital human experience is now indissolubly their own."

A recommendation strong indeed but, in my opinion at least, valid in the context of this remarkable record. ■

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Mr Eric Cleburne, Technical Director of the World Record Club here in Australia, mentions the speaker under "ADDING A TWEETER" in the Oct., '65, issue of "World Record News" by saying: "A SUPERB LITTLE SWEDISH DESIGN SUITABLE FOR INCLUSION IN BASS CABINETS, OR AS A SEPARATE UNIT, IS THE SHB. ALTHOUGH ONLY 2¼in IN DIAMETER, A SHB TWEETER IS IDEAL FOR HIGH QUALITY INSTALLATIONS."
Electronics Australia have reviewed the speaker in their April, '66, issue and here is an excerpt: "THE UNIT WAS TESTED UNDER THESE CONDITIONS (CROSSING OVER AT 5 KC) IN A PLAYMASTER BOOKSHELF UNIT AND PERFORMED VERY WELL INDEED. ITS SEALED-BACK CONSTRUCTION HAS AN OBVIOUS ADVANTAGE FOR FULLY SEALED ENCLOSURES, WHILE THE SMALL SIZE IS ALSO ATTRACTIVE, WHERE SPACE IS LIKELY TO BE A PROBLEM."

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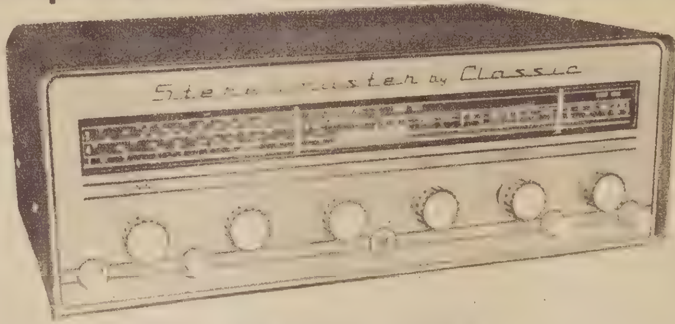

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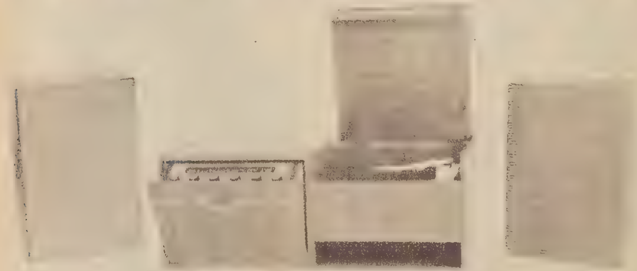

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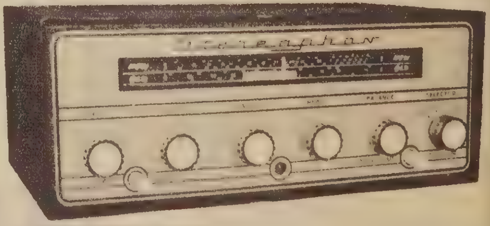

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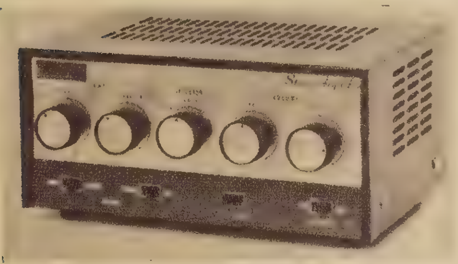

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# VARIETY FARE

“ELECTRONICS Australia”
Staff Review
Panel

## Devotional

**LORD OF GLORY. The Revivaltime Choir directed by Cyril McLellan. Stan Ramsey, piano; Sharon Ramsey, organ. Stereo, Word (Gospel Film Ministry) WST-8142-LP.**
Interest: Gospel radio choir.
Performance: Outstanding.
Quality: Clean.
Stereo: Very good spread, definition.

The very first few bars on this album had a promise of good sound to come and the promise is completely vindicated.

On the air since 1953 and now serving some 450 radio stations in the U.S. networks and abroad, the choir is an integral part of the “Revivaltime” session, produced by the Assemblies of God from their 645-seat studio in Springfield, Missouri.

As one would expect of such a choir, their singing is bright, tuneful, and well balanced. Their program here is a happy mixture of well known Gospel hymns and more modern Gospel songs and choruses: He’s The Lord Of Glory—Under His Wings—He’s A Wonderful Saviour—The Wonder Of It All—Pentecostal Fire Is Falling—What A Day That Will Be—He Belongs To Me—“Heaven” Medley—No Name Has Meant So Much—I See Jesus—Souls, Lord—Give Him The Glory—The Great Physician—The New Song.

Very well recorded, the general balance is excellent, as also is the diction, by reason of careful placement of lead vocalists. And the stereo is quite outstanding, with groups and instruments very well defined.

Strongly recommended. (W.N.W.)

* * *

**NOW THANK WE ALL OUR GOD. The London Crusader Choir conducted by Rev. Douglas B. Gray. With Paul Mickelson, organ and piano; recorded at Holy Trinity Church, London. Stereo, Supreme SS-2002. Also available in mono SM1002, (Supreme Productions Ltd., Box 15, Footscray, Vic.).**
Interest: English evangelical choir.
Performance: Sincere.
Quality: Good.
Stereo: Good spread.

There is an interesting contrast beween this album and “Lord Of Glory” lso reviewed in these columns. In the atter, the “Revivaltime” choir has been rained for maximum impact over the adio medium, with lead vocalists and roups and a constantly changing pattern of sound to catch the listening ear.

The Crusader Choir, on the other and, specialises more in personal appearances, though these range from the oncert platform and large evangelical allies to meetings in humble mission houses and particularly in prison chapels, where much of the choir’s ministry has centred. Their presentation is characterised by straight four-part choral harmony, but very well balanced and well disciplined.

Full credit must also go to accompanist Paul Mickelson and to the conductor—Rev. Douglas B. Gray — who, incidentally is also conductor-in-chief of the London Festival Male Voice Choir.

Thine Be The Glory—And Can It be —My Faith Looks Up To Thee—Praise Ye The Father—Rejoice Ye Pure In Heart—O Love That Will Not Let Me Go—To God Be All The Glory—The Spacious Firmament — Jesus Keep Me Near The Cross—Blessed Assurance — In The Name Most High—Now Thank We All Our God.

A good choir and traditional choral sound. (W.N.W.)

**60 MEN SING. The Sydney Methodist Brotherhood Choir. Conducted by Norman Tange. Accompanist, Joyce Tange. Mono, Festival FL-31,877.**
Interest: Male choir.
Performance: Smooth.
Quality: Good.

During 1955, a group from the Methodist Brotherhood Movement in Sydney conceived the idea of forming a temporary choir for the N.S.W. Annual Methodist Conference. Such was the reception afforded the group, and the enthusiasm of its members, that the choir continued training under its conductor, Norman Tange, gradually expanding its repertoire from simple Alexander hymns to sacred songs, spirituals, madrigals, modern art songs, ballads and operatic choruses. The choir has since appeared on radio and television and in eisteddfods with notable success.

Here the group presents a typical program, not exclusively devotional but of the type likely to interest buyers of devotional records. Their sound is smooth, tightly disciplined and full: Passing By—Like To The Damask Rose—Where E’er You Walk—I Want To Be Ready—Swing Low Sweet Chariot—Doctor Foster — Love Could I Only Tell Thee—Sylvia—Blow The Wind Southerly—All in The April Evening—I Heard A Forest Praying—Songs Of Praises.

Cleanly recorded by Festival, the album is well worth a hearing by anyone with an interest in local choirs. (W.N.W.)

## Instrumental, Vocal & Humour

**COMPOSERS’ PROMENADE. The Vienna Promenade Orchestra conducted by Hans Hagen. Violin, Hans Grotzer. Stereo, Festival SFL-931,844. Also available in mono FL-31,844.**
Interest: Snippets from the classics.
Performance: Limited scale.
Quality: Clean.
Stereo: Normal.

In a modest kind of way, this record is pleasant enough, as one might expect of a small Viennese orchestra playing a series of familar and tuneful snippets. But, at the same time, it lacks any real orchestral weight and gets no help from the markedly non-reverberant environment in which the recording has been made. Even the recording level is modest.

The tracks contain fourteen items, some quite brief: Dance Of The Hours—Adagio—Wedding Day In Troldhaugen —Valse Triste—Hungarian Dance No. 5—Meditation—Humoresque — Anitra’s Dance—Waltz In A Major—Menuet—Waltz From Sleeping Beauty—Slavian Dance No. 2 In E Minor — Wedding March.

Pleasant enough but limited. (W.N.W.)

* * *

**ITALIAN ROMANCE — AMERICAN STYLE. Frank DeVol and his orchestra. Ampar (Festival) 12-inch stereo, SML-931,827. Also in mono ML-31,827.**
Interest: Americanised Italiana.
Performance: For dancing.
Recording: Very good.
Stereo Quality: Dichotomous.

Frank De Vol and his orchestra present on this disc a dozen popular Italian tunes arranged and played in the American “style”; as far as I can tell this seems to mean that they all come out fox-trots. This is not meant as criticism but explanation, for they make pleasant listening and would of course be fine for dancing. My only query is with the implication that the film “La Strada” was a romance—surely De Vol wouldn’t have us believe that?

The tunes on the disc are Al Di La—La Strada—Non Dimenticar—Ciao Ciao Bambina — Anima E Core — Forget Domani—Summertime In Venice — Arrivederci Roma — More (theme from “Mondo Cane”)—Volare—Senza Fine—Casa Del Sol.

The recording and stereo are very good, although the stereo is virtually dichotomous. (J.R.)

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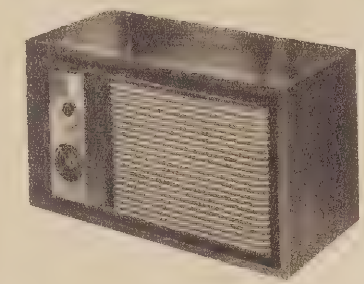

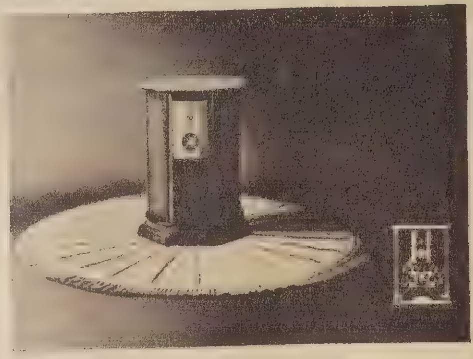

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## READER'S DIGEST SET

**ORGAN MEMORIES. Reader's Digest 4-record set in box. Recorded by RCA in Dynagroove; Stereo and mono.**
Interest: Organ, popular and classical.
Performance: Good.
Quality: Good but some tape hiss.
Stereo: Excellent spread, definition.

In no small degree, this set might be regarded as a tribute to Robert Hope-Jones, pioneer of the entertainment type organ. The introductory notes to the album have largely to do with Hope-Jones, while the first three discs are devoted to music played on pipe Wurlitzers.

Record 1, "Down Memory Lane" is presented by the timeless Reginald Dixon from the Tower Ballroom at Blackpool, England. It is a typical Dixon recital, with a strong rhythm developed from his many years in the world's most famous ballroom, yet relieved from any sense of the mechanical by his effortless counter-melodies and his overall virtuosity at the console.

As might be expected, Dixon plays a variety of Wurlitzer evergreens: Tea For Two, Susie, Ain't She Sweet, Four Leaf Clover, etc.

Record 2, "Spectacular Melodies" introduces British organist, Reginald Foort, playing another Wurlitzer, larger than the Blackpool organ but installed in the private home of television actor, the late Joe Kearns. Reginald Foort, with more of a classical background than Dixon, offers The Poet And Peasant Overture, Barcarolle from the Tales Of Hoffman, Intermezzo from Cavalleria Rusticana and Hungarian Rhapsody No. 2, along with lighter numbers, including a couple in the Jesse Crawford manner.

The largest Wurlitzer in the world features on Record 3, "Twilight Reveries" — the huge instrument in the 6,000-seat Radio City Music Hall, New York, with its twin consoles, eight organ chambers, 56 ranks of pipes, and all the other Wurlitzer gadgetry. On this organ, Raymond Bohr makes no attempt to produce the world's largest sound but contents himself with a relatively conservative presentation of sentimental themes like Tenderly, Serenade, Estrellita, The Swan, Love Letters, O Promise Me, etc. While describing the performance as conservative, I suspect that the microphone placements have favoured the pipe ranks and done inadequate justice to Bohr's piano and percussion embellishments.

After three records of Wurlitzers, it is a relief to turn to number four, "The Organ Triumphant" presented by Virgil Fox on instruments of more classical derivation, even though their electric action may have borrowed some of the Hope-Jones techniques.

On side 1, playing the organ of the Royal Albert Hall, London, Virgil Fox presents Toccata And Fugue in D-Minor, Trumpet Tune And Air, Little Fugue in G-Minor and Toccata from Symphony No. 5 (Widor). On side 2, playing the more mellow-sounding organ of the Riverside Church, Manhattan, of which he is regular organist, Fox presents Air For G-String, Sheep May Safely Graze, Arioso, and Sleepers Awake, all by Bach.

These are familiar titles — perhaps too familiar to some — but they are a logical choice when the aim is to associate and contrast them with well known items from other fields, under the general title of "Organ Melodies."

From the technical viewpoint, the sound of all four records is well balanced, free from any suggestion of distortion and, in the case of the stereo pressings, well spread. Unfortunately, there is a background of tape hiss in most tracks — the old bugbear of organ recordings—but I don't think that it will prevent anyone interested in this kind of organ music from gaining full enjoyment from the set. In fact I would rate it as a good buy for any recording library at $9.99 and a "must" for popular-pipe-organ enthusiasts. (W.N.W.)

**HOLLYWOOD MOVIE HITS, Vol. 2. Frank Chacksfield and his orchestra. Decca Ace of Clubs 12-inch mono, ACLA 1188.**
Interest: Famous movie tunes.
Performance: Smooth.
Recording: Very good.

Well-known tunes from hit Hollywood movies of the 40s and 50s are featured n this disc from Frank Chacksfield and is orchestra, played brightly and moothly in the style appropriate to that ra. It makes very enjoyable listening.

The tunes played are: On the Atchion, Topeka and the Santa Fe — Zip-Dee-Doo-Dah — Buttons and Bows — Baby It's Cold Outside — Mona isa — In the Cool, Cool, Cool of the vening — High Noon — Secret Love — Three Coins in the Fountain — Love s a Many Splendoured Thing—What ver Will Be Will Be (Que Sera, Sera) —All The Way.

The recording quality is quite high, naking the disc excellent value at the conomy price level. (J.R.)

**SCHEHERAZADE. Rimsky-Korsakoff. The Royal Philharmonic Orchestra conducted by James Walker. Stereo, Reader's Digest-RCA Dynagroove, SPS-13 (Readers Digest Assoc. Pty. Ltd., 86 Stanley Street, East Sydney).**
Interest: High quality, low cost.
Performance: Good.
Quality: Very good.
Stereo: Also very good.

Normally a record like this would be reviewed by Julian Russell, who would be in a much better position than I to compare it with the countless other Scheherazades that have been issued on LP discs, almost since they first hit the market. If you already have a good one, you may not need another, but this one should tempt most everyone else, when it is pointed out that the special Readers Digest price for it is just one dollar, and no strings attached—apart, I imagine, from getting your name on their mailing list as a potential customer.

But it's certainly not the kind of

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record you'll ever need to apologise for. The performance by the Royal Philharmonic Orchestra is excellent, as also is the quality, the stereo and the pressing. It comes in a normal jacket carrying copious notes about the music, which should be specially valuable to those having limited acquaintance with classical orchestral music.

The four tracks, relating to titles of stories, which the bride Scheherazade tells the Sultan, are: The Sea and The Vessel of Sinbad—The Tale of the Prince Kalender — The Young Prince and the Young Princess — Festival at Bagdad—The Sea—The Vessel is Wrecked. Conclusion.

Just about the best value among LP recordings (W.N.W.).

★ ★ ★

**SAIL ALONG SILV'RY MOON. Billy Vaughn and his Orchestra. Stereo, Festival SZL-931,700. Also available in mono ZL-31,700.**

Interest: Rhythmic melody.
Performance: Swinging.
Quality: Clean.
Stereo: 3-channel variety.

At first sight of these sentimental titles, and knowing Billy Vaughn, one rather expects an album of melodic but dreamy love songs. But nothing of the kind. To be sure, Billy Vaughn is right out front with his singing sax, but, in the right-hand channel, prominent percussion keeps things moving right along, with the open invitation to get up and "choose your partner."

The titles: Sail Along Silv'ry Moon—Sunrise Serenade—Sweet Georgia Brown—Sentimental Journey—Until Tomorrow —Jealous — Raunchy—Twilight Time — Sleepy Time Gal — I'm Getting Sentimental Over You — Moon Over Miamo Miami — Tumbling Tumbleweeds.

Tuneful, danceable, listenable and excellent quality (W.N.W.).

★ ★ ★

**RICHARD RODGERS. "Victory At Sea," "Slaughter On Tenth Avenue." Hill Bowen and his orchestra. Arrangements by Robert Russell Bennett. LEONARD BERNSTEIN. Symphonic Dances from "West Side Story." Lad Busby and his orchestra. Reader's Digest-RCA Dynagroove 12-inch stereo, SP-2.**

Interest: "Program" music.
Performance: Sparkling.
Recording Quality: Excellent:
Stereo: Wide, smooth.

Another of the excellent Reader's Digest-RCA productions selling for the incredibly low price of $1.00. And as with the first of these to come my way, it is a real winner. With bright, warm playing, popular music and superb recording on RCA Dynagroove, it's virtually irreproachable.

The three works played are what might be called popular "program" music. The first is Victory at Sea, the symphonic scenario composed by Richard Rodgers and Robert Russell Bennett for the TV documentary series of the same name, produced by the NBC. Then follows Rodgers' well-known and haunting Slaughter On Tenth Avenue, and finally Leonard Bernstein's symphonic dances based on the music of the Jerome Robbins-Arthur Laurents musical "West Side Story." The latter with its restless, moody turbulence seems to capture the atmosphere of the musical extremely closely, and makes exciting listening indeed.

—"TV TIMES."

As I said before, an excellent disc in all respects. And unbeatable value at R-D's price. Note that the disc can only be obtained direct from the Reader's Digest Association Pty. Ltd., at Box 65, G.P.O., Sydney. (J.R.)

★ ★ ★

**FAMOUS TANGOS, featuring the orchestras of Carl de Groof, Lutz Albrecht and Erwin Hallet. Stereo, Festival SFL-931,845. Also available in mono FL-31,845.**

Interest: Dance music.
Performance: Fair.
Recording: Good.
Stereo: Normal.

The music presented is in strict dance tempo and includes many well-known tango melodies. Designed for dancing, they also make fair listening. Although pleasant, the arrangements do lack brightness. There is little to choose between the style and performance of the three orchestras featured and one is left with the feeling that the complete record could have been made by any one of the three without much affecting the result, as heard.

Tracks feature: Jalousie — Tico Tico — Hear My Song, Violetta — My Prayer — Roulette — Tango Bolero — Blue Skies — Adios Muchachos — Blue Tango — Ole Guapa — The Stars Are Shining — Adios Pampa Mia.

This record was originally recorded by Elite Special Switzerland and the quality of the Australian pressing is quite good (K.W.).

★ ★ ★

**NEW STEREO SOUND OF THE LAWRENCE WELK ORCHESTRA. Dot (Festival) stereo 12in, SZL-2/7.**

Interest: Popular melodies.
Performance: Crisp and bright.
Quality: Excellent.
Stereo: Well spread.

This record is a stereo sampler featuring tracks selected from various Lawrence Welk discs. The whole performance is bright and pleasant, the excellent recording quality displaying the skilful arrangements. Combine the above with favourite melodies and the result is a disc which can only have a high appeal.

The tracks: Java — Tales From The Vienna Woods — Little Things Mean A Lot — Never On Sunday — Canadian Sunset — Baby Elephant Walk — Apples And Bananas — A Tree In The Meadow — The Happy Wanderer — After The Ball — The Girl From Barbados — Our Day Will Come.

Being a stereo sampler, the album is available at the very reasonable figure of $3.95, making it that much more attractive (K.W.).

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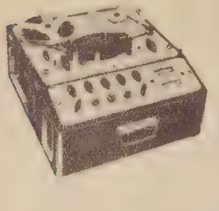

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**STRAUSS, arr. Dorati: Graduation Ba —Ballet. WEBER, arr. Berlioz: I Spectre de la Rose—Ballet (Invit tion to the Dance, Op. 65). Wi Boskovsky conducting the Vienn Philharmonic Orchestra. Dec "Ace of Diamonds" 12-inch stere SDDA-127. Also in mono c ADDA-127.**

Interest: Ballet music.
Performance: Sparkling roma ticism.
Recording Quality: Excellent.
Stereo: Smoothly spread.

"Graduation Ball" is a ballet with somewhat interesting history. It wa "made up" by choreographer Davi Lichine and musician Antal Dora largely from previously unpublishe Johann Strauss pieces which they foun in manuscripts in the Vienna Sta Opera library. Of added interest that it was first performed in Sydne on February 28, 1940, at the Theatr Royal.

"Le Spectre de la Rose" is based c the well-known Invitation To Th Dance, which Hector Berlioz orche trated in 1841 from a piano piec "Rondo Brilliant" written by Weber i 1819. It was first performed in Mon Carlo in 1911 by the Diaghilev ball company. A fantasy, it is the story c a young girl whose dream lover briefl appears, dances with her, and the changes into a rose.

Both works make very delightf listening, particularly when played in th sparkling romantic tradition as her Boskovsky and the Vienna Philharmoni really make them glow. Perhaps should be mentioned that Graduatio Ball includes the well-known "Perpetuu Mobile" among its many very pleasar melodies.

The recording on this Ace of Dia monds disc is, as one would expect, c excellent quality. Surface and tap noise are very low and there is negl gible distortion. The stereo sound i smooth and well spread.

Highly recommended. (J.R.)

★ ★ ★

**VIVA MEXICO! Herb Alpert and th Tijuana Brass. Universal Recor Club, Stereo SUP 759, Mono U 759.**

Interest: Music played Latin Ameri can style.
Performance: Cool, moody.
Quality: Very good.
Stereo: Excellent spread.

In another Tijuana Brass record re viewed in these columns recently, th performances were lively and evocativ of a happy carefree atmosphere. In thi record, the mood changes, and Her Alpert with his ensemble plays in th style of the cool school, but the sam magic is there, which transforms eve such a tired old number as "South o the Border" into a pleasant musical ex perience.

It will be noticed that some of th numbers included in this selection hav not even the remotest connection wit Mexico, which might cause some com ment on the accuracy of the disc's title The justification, if such be sought after is that the group plays throughout in th Mariachi rhythms of Mexico. If yo liked the other Tijuana Brass records this is for you.

The first number on the second sid is the famous "Lonely Bull," which wa Herb Alpert's first big success, and le to the formation of the Tijuana Bras The full list of titles is: South of th

# TEST RECORD

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**PROFESSIONAL TEST RECORD, mono and stereo. Concert-Disc (W. & G.) WG-25/2434.**
Interest: Test record.
Versatility: Good.
Quality: Excellent value.

W. & G. Records have recently released this local pressing of the Concert-Disc PTX-10 test record, which was designed both as a working tool for the audio engineer and as checking facility for the advanced audio enthusiast. The disc is somewhat unique in that it contains on the one disc the majority of both the mono and stereo tests currently used in system checking.

Side one features mono test tracks. It commences with a reference track of 1KC tone recorded at 5.5cM/S—"standard recording level." This is followed by a frequency run recorded at —6dB. The run is somewhat shorter than usual, but would be adequate for most purposes: the tracks are 10KC, 7KC, 3KC, 1KC, 250cps and 60cps. The 10KC tone is used in conjunction with a similar track at the end of the side for testing translation loss.

Following the frequency run tracks are three white-noise tracks in which sharp-cutoff filters are alternately switched in and out to permit a quick check of HF response and one which is virtually independent of room acoustics. The filters used cut off at 15KC, 12KC and 10KC respectively. Following these three tracks is a track having two minutes of white-noise for subjective comparisons and listening tests.

An up-and-down chromatic scale played on a piano is provided for transient testing. This is no doubt quite useful, but is perhaps a little disappointing in view of the current preference for square-wave testing of transients. The advantage of square-waves is that they permit convenient observation and recording using a standard oscilloscope.

Following the chromatic scale track are four tracks which may be used for testing cartridge tracking. They feature single notes played on a bass drum at plus 4dB, plus 8dB, plus 12dB and plus 16db. As the sleeve notes point out, very few modern cartridges will remain in the last of these tracks at reasonable playing force; in fact there are not too many which will reproduce the plus 12db track without obvious embarrassment.

As mentioned earlier, side one ends with a second 10KC tone track for translation loss comparisons.

Side two commences with 1KC reference tones for both left and right channels recorded at the standard stereo level of 3.9cM/S. This is then followed by a frequency run similar to that on the mono side but with each tone provided first for the left channel and then for the right channel to allow convenient measurement of channel balancing and cross-talk.

In place of the white-noise tracks the second side has tracks for channel orientation, phasing, and wow and flutter. These are followed by two short music tracks for convenient reference. The final two sets of tracks provide for signal-to-noise and stereo translation loss tests.

The disc is accompanied by informative sleeve notes.

Use of the disc is greatly facilitated by clear and concise verbal announcements.

In all, then, a most useful test record which will no doubt be of interest to many audio workers. Two additional features are that it is readily obtainable throughout Australia, and its attractively low cost: only $2.50 retail. Record stores may order the disc from W. & G. Distributing Co. (N.S.W.) Pty. Ltd., of 30-40 Gibbens Street, Camperdown. (J.R.)

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★ ★ ★

**BACKGROUND MOODS FROM THE MOVIES. Gary Hughes and the London Cinema Orchestra. Charles Docker, piano solo. Reader's Digest-RCA 12-inch Dynagroove stereo, SP-9.**
Interest: Popular movie themes.
Performance: Big and bright.
Recording: Top-notch.
Stereo Quality: Smooth, wide.

Another recording of movie themes, to be sure, but this one is not in the usual class. The playing is expansive, bright and warm; the themes are a dis-

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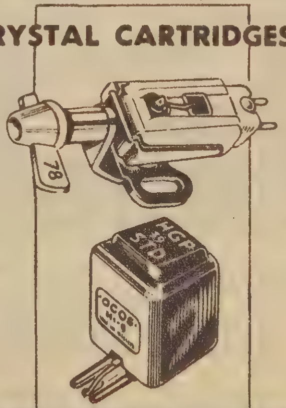

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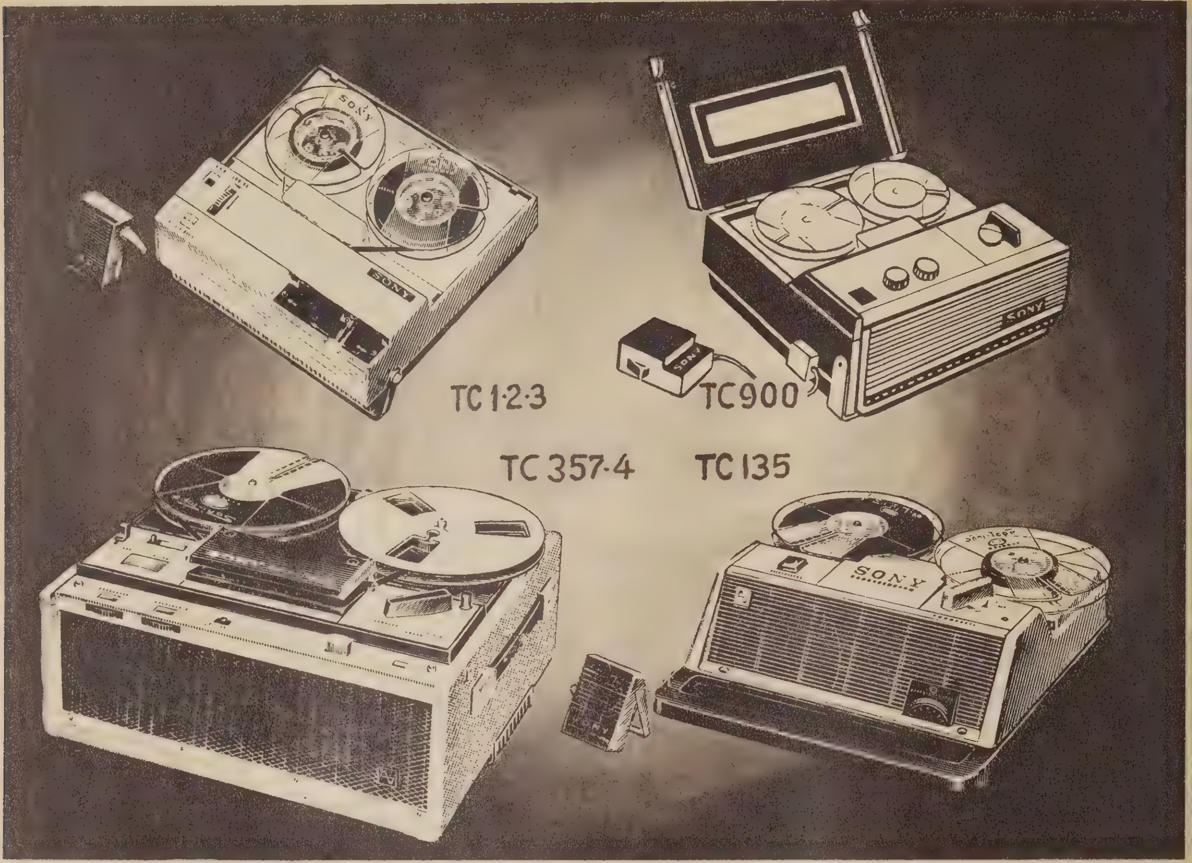

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tillation from hit movies ranging over 30 years; and the recording is RCA Dynagroove at its very best: superb. It's the sort of disc a reviewer hates, because one can't find anything about it to criticise! All I can say is that it's a real winner.

And yet how much do you think Reader's Digest are asking for it? The staggering sum of one whole dollar—$1.00. If it's an advertising stunt, there should be more of 'em; if it's not, R-D have finally flipped their corks. . . .

The tracks are: Charade—Days of Wine and Roses—Title Theme from Tom Jones—Golden Earrings—Theme from The Apartment—Theme from Lawrence of Arabia — Theme from A Summer Place—Title Theme from Anastasia—Theme from La Dolce Vita—Title theme from Deception—Love for Love—The Sweetest Sounds.

Copies of the disc are obtainable only from Reader's Digest Association Pty. Ltd., Box 65, G.P.O., Sydney. (J.R.)

★ ★ ★

**THE IMMORTAL PERCY FRENCH. Brendan O'Dowda with Philip Green and his orchestra. Mono, Columbia 330SX-7756.**

Interest: "Irish troubadour."
Performance: Excellent.
Quality: Good.

To precis the biographical notes on he jacket, Percy French was born at Cloonyquin, Co. Roscommon, in 1854, ind, despite his family's poverty, was ent to Trinity College, Dublin, to study ivil engineering. But Percy French was nore interested in writing, painting, nusic and the stage. He tried his hand t all these activities, ending up in London in 1900, where he became a highly uccessful entertainer, with his banjo, is songs and his lightning sketches, nost of which revealed his basic love or his native Ireland. Through World Var I, he spent much time intertaining roops, and died in 1920.

Irish tenor, Brendan O'Dowda, is recgnised as a leading exponent of Percy rench's whimsical songs and, in this lbum, he presents a group of songs, hich are highly enjoyable, with their pically Irish lilt, idiom and humour: lattery's Mounted Fut—The Mountains f Mourne — Whistlin' Phil McHugh - Gortnamona — Come Back Paddy eilley — McBreen's Heifer — Phil The luter's Ball—The Emigrant's Letter—ileen Oge—Father O'Callaghan—Are ou Right There Michael?—Donegan's aughter.

Songs, voice, diction and accompanient are all good, adding up to an bum well worth a hearing, if the connts appeal (W.N.W.).

★ ★ ★

**PERETTA EVERGREENS. Hilde Gueden (soprano) with the Vienna State Opera Orchestra conducted by Robert Stolz. Decca Ace of Diamonds, Stereo SDDA 132, Mono ADDA 132.**

Interest: Soprano arias from operettas.
Performance: Competent.
Quality: Good.
Stereo. Not particularly noticeable.

Both Hilde Gueden and Robert Stolz internationally famous in their resctive spheres for their performances operettas, so it is not surprising that performances on this disc are comently rendered. Madame Gueden's ntrol of pitch and phrasing are mplary, but there is a certain stiffs in her delivery which becomes noticeable here and there. This is particularly so in the "Laughing Song" from Die Fledermaus, where her deliberate and separate enunciation of the "Ha, ha, ha's" sounds more like the hollow mirth following the telling of a bad joke rather than the rippling laughter of the coquette Adele. It should be noticed however, that Madame Gueden usually sings the part of Rosalinde in this operetta, for which her style is much better suited.

Presumably the material presented here is taken from recordings made a few years ago, since the sound quality does not quite attain the excellent standards of modern recordings, although it is still very good. There was also a slight but noticeable surface noise on the review record. The stereo spread is not significant enough to warrant attention.

As a selection of evergreens from operetta, some of the numbers chosen contrast strangely with the omissions. One might have expected to find something from "Merry Widow" for example, especially the famous "Vilja" aria, which Madame Gueden sings very well on another Ace of Diamonds recording.

Be that as it may, here is what you get on the disc: Entry of Mariza — Sag Ja (both from Grafin Mariza) — Mein Liebeslied Muss Ein Walzer Sein (White Horse Inn) — Kosende Wellen (Der Zarewitch) — Heut' Konnt' Einer Sein Gluck Bei Mir Machen (Madame Pompadour) — Nuns' Chorus (Casanova) — Hor Ich Cymbalklange (Zigeunerliebe) — Du Sollst Der Kaiser Meiner Seele Sein (Der Favorit) — Mein Herr Marquis (Adele's Laughing Song from Die Fledermaus) — Sie Nicht Bos (Der Obersteiger) — Held Meiner Traume (The Chocolate Soldier)—Wiener Blut. (H.A.T.)

★ ★ ★

**BALLADS OF THE GREEN BERETS. S.-Sgt. Barry Sadler, songs arranged and conducted by Sid Bass. RCA Dynagroove, Stereo LSP-3547, Mono LPM-3547.**

Interest: Vietnam war songs.
Performance: Good of its type.
Quality: Very good.
Stereo: Well done.

This record received a vicious mauling at the hands of critics in U.S.A., who described S.-Sgt. Barry Sadler's tunes as "amateur" and his lyrics as "corny." The subsequent success of the record and its present position high on the list of the hit parade shows once again that the opinions of critics do not necessarily reflect public taste.

Apart from the first number, "Ballad of the Green Berets," which extols the virtues of the men chosen to serve in this elite American fighting unit, the songs on this disc could be described as the "cris de coeur" of an American fighting man in Vietnam. In view of Australia's involvement in the same conflict, the sentiments expressed will strike a sympathetic chord here. The situations described must be regarded as authentic, since Barry Sadler is a Vietnam combat veteran.

The tunes themselves have a familiar ring, and one realises that they have a close affinity with the ballads of the cowboy era. The best advice I can give intending purchasers is to get to know the songs from the repeated playings over the radio. If you like them, I can otherwise recommend this disc, since the sound quality and stereo separation are both excellent.

The Ballad of the Green Berets—

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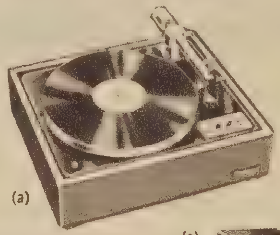
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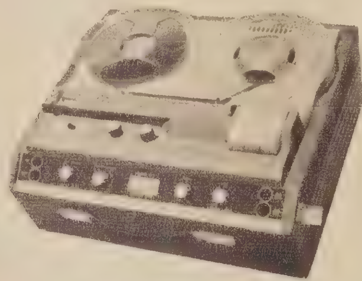

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★ ★ ★

**JAMBOREE with The Cattlemen and Frank Saunders. Readers Digest, Stereo SP6.**

Interest: Traditional and modern cowboy songs.
Performance: Generally good.
Quality: Very good at the price. Stereo. Normal spread.

This disc is one of a number currently being released by "Reader's Digest" at the astonishingly low price of $1. The standard of performance and sound quality is far better than one is entitled to expect at this price, so people who may have been disappointed in the past with "bargain price" records need have no such fears on this occasion. The record is available direct from Reader's Digest, Box 65, G.P.O., Sydney.

The record features songs associated with the cowboy era. Some are the genuine product, others are the Hollywood variety, but they are all good tunes. On one side of the disc, The Cattlemen give their renderings of six songs, while the other side is devoted to Frank Saunders with guitar singing six more. Frank Saunders has the virtue of sounding authentic, if you disregard the female choir which intrudes from time to time. The Cattlemen sound exactly what they are, a group of radio entertainers grouped around a microphone, singing slick harmonised arrangements. One seldom hears these grand tunes on the radio nowadays, so if you like cowboy songs, here is a change to obtain a good selection for a bargain price.

Side 1 (The Cattlemen). Red River Valley — The Yellow Rose of Texas—Cool Water—Tumbling Tumbleweeds—The Last Round-up—Wagon Wheels. Side 2 (Frank Saunders). Home on the Range—Clementine—Oh, Susanna—The Old Chisholme Trail—Blue Tail Fly—Kentucky Babe. (H.A.T.)

★ ★ ★

**OLTERS, BUSHRANGERS AND DUFFERS. Traditional Australian Songs, sung by Gary Shearston. With Richard Brooks on harmonica, Kemp Fowler on concertina, Les Miller on banjo and guitar. CBS 12-inch mono, BP-233288.**

Interest: Australiana.
Performance: Authentic, moving.
Recording: Variable; satisfactory.

Authenticity is the keynote of this ecording of songs of the bushranging ra, presented by well-known local folkinger Gary Shearston. Two songs are resented without accompaniment; e rest have a poignant backing with armonica, concertina, banjo or guitar. hearstone himself avoids sentimentality, dopting a dry and forced tone which ometimes oppresses but often illuinates the passions in the songs to a emarkable and occasionally very movg degree.

Accompanying the disc is an informave and poignantly illustrated set of otes prepared by Edgar Waters, giving e background to each of the songs d discussing the men whose precarious istence and exploits form the contents. The songs presented are Moreton Bay—Jim Jones—The Cyprus Brig—Bold Jack Donahue—The Maryborough Miner—Frank Gardiner—Jack Power—The Wild Colonial Boy—Wallaby Stew—The Eumerella Shore—Ben Hall—The Death of Ben Hall—The Streets of Forbes—My Name is Edward Hall—Farewell To Greta—Stringybark Creek.

The recording quality is somewhat variable, with occasional microphone overload evident on sibilants and plosives, but otherwise quite satisfactory.

For those who seek authenticity, recommended. (J.R.)

★ ★ ★

**PAT BOONE SINGS WINNERS OF THE READER'S DIGEST POLL. Mono, Dot (Festival). ZL-31,860.**

Interest: Selected favourites.
Performance: Fair.
Quality: Good.

The performance of the accompanying orchestra, conducted by Pete King, is above average and, except in two tracks his arrangements leave little to be desired.

Unfortunately, the same cannot be said of the singer. Pat Boone's tendency to turn the word "and" into a groaned-out sentence, together with his jazzed up version of Ol' Man River, did nothing to win over this reviewer. And, while he has a reasonably pleasant voice, the sameness of it becomes wearisome after three or four tracks.

The saving feature of the disc is the group of "evergreen" melodies featured, among those being a very old one, "Greensleeves," which appears under the title "We Gaze On Tomorrow."

Other tracks are: You'll Never Walk Alone — Misty Moonlight Serenade — Smoke Gets In Your Eyes—Tonight—Night And Day—Tea For Two—All The Things You Are — I Left My Heart In San Francisco — As Time Goes By.

A moderately pleasant disc — when taken in small doses (K.W.). ▬

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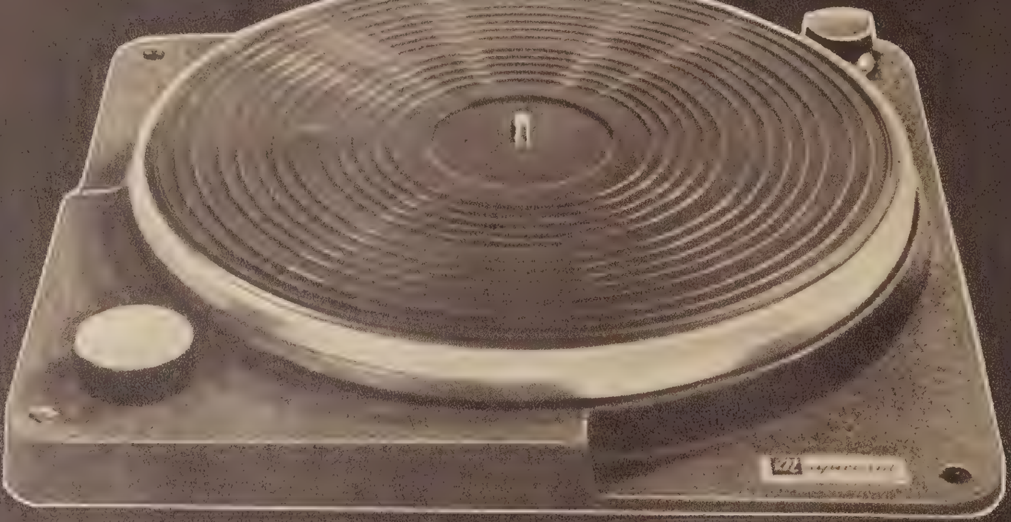

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# POPULAR JAZZ

Reviewed by GRAEME BELL

**GOLDEN TROMBONE FAVOURITES. Warren Covington and His Orchestra. Stereo, Festival SDL-931,813. (Also available in Mono.)**

Interest: Trombone.
Performance: Excellent.
Quality: Excellent.
Stereo: Normal spread.

Here is a really first-class trombonist paying tribute to the great jazz trombonists who have appealed to him in the course of his career. While not attempting to impersonate the originators, Warren Covington displays great familiarity with the distinctive phrasing and tone of creative men who have shaped the progress of this beautiful instrument.

"It's All Right With Me" is one of the best tracks, recalling the great team of J. J. Johnson and Kai Winding with one of the best arrangements on the disc. Trummy Young's "Margie," Miff Mole's "Peg O' My Heart," Tommy Dorsey's "I'll Never Smile Again" and Jack Teagarden's "I Gotta Right To Sing The Blues" are just some of the great performances in this very satisfying "New World of Sound" album.

* * *

**DUKES OF DIXIELAND. Recorded "Live" at Bourbon Street, Chicago. New World of Sound (Festival), Stereo SDL-931-773. (Also available in Mono.)**

Interest: Traditional Jazz.
Performance: Very good.
Quality: Very good.
Stereo: Normal.

On this disc the Dukes come up much better than I've ever heard them before—and what a treat to find Barrett Deems on drums and Gene Schroeder on piano! But the star is unquestionably erry Fuller, whose inventive clarinet always holds interest. Chicagoan Dave Remington replaces the regular Freddie Assunto on trombone, and the rest of he personnel is made up of Frank Assunto on trumpet, Papa Assunto on banjo and trombone, and Red Brown on bass. The rhythm section swings like mad on some tracks, but the most notable hing about the whole album is the hoice of tunes.

The big fault of nearly all American Dixieland records is the monotonous repeating again and again of Dixieland tandards, but on this album the Dukes have taken a leaf out of the English jazz bands' book, and given a jazz treatment to some non-jazz tunes such as "Fiddler on the Roof" (the most interesting tune on the record), "Charade," "More," "I Will Wait For You" (theme from "Les Parapluies De Cherbourg"), in addition to such old faithfuls as "High Society" nd "South Rampart Street Parade."

This is first-class happy jazz, by a band which is doing big business in the States, nd the audio quality is good.

**FRANK COUGHLAN AND HIS DIXIELANDERS. Readers' Digest-RCA, Stereo RDS-SP8. (Also available in Mono.)**

Interest: Mainstream jazz.
Performance: Moderate.
Quality: Too much echo.
Stereo: Doesn't add anything.

This was recorded in Sydney, and apart from the leader on trombone, features Ken Brentnal trumpet, Jim Ryan clarinet, Ron Murray tenor saxophone, Ed Gaston bass, Colin Nolan piano, and Johnny Sangster and Tom Bone on drums.

Frank Coughlan is the father of Australian jazz, and as such has had a great influence on other players in this country. I well remember my brother Roger and our contemporaries in Melbourne worshipping at the feet of this great musician at the Faulkner Park Kiosk on Sunday afternoons, way back in the late thirties. However, it is now 1966, and I wonder why this man was not recorded by one of the leading companies when he was in his prime.

To my mind the cover design leaves a lot to be desired; another criticism I would add is that the sleeve notes have nothing to do with the record contents. However, against this we can set the fact that the disc can be bought for the very low price of one dollar, with no strings attached, from Reader's Digest Association, 86 Stanley Street, East Sydney.

* * *

**STANDING OVATION AT NEWPORT. Herbie Mann. Atlantic (Festival), Stereo SAL-931,816. (Also available in Mono.)**

Interest: Modern jazz.
Performance: Warm and exciting.
Quality: Very good.
Stereo: Normal spread.

Three of the four tracks on this album were recorded live at the Newport Festival, and the fourth was cut at the Village Gate. If you like jazz flute and a boom-chitty rhythm like Watermelon Man, then this disc is a must, because Mann blows more flute than you're likely to find.

Apart from Herbie, you'll hear swinging piano from Chick Corea on "Stolen Moments," conga drumming from Carlos Valdes on "Patato," and some biting trombone from John Hitchcock and Mark Weinstein on Mann's original "Mushi mushi."

The group is completed with vibist Dave Pike, bassist Earl May, drummer Bruno Carr; and for "Comin' Home Baby," Herbie called upon its composer, bassist Ben Tucker, to join them in a performance which earned them such a standing ovation that they had to return to the stage before the next act could come on. ▭

*This is the world's Finest Pre-amplifier*

**DYNAKITS**

**PAS—3X**

Dynaco pre-amplifiers have such low distortion and noise, such high quality that it seemed pointless to attempt improvements. Now, however, there is a new worthwhile modification which retains the infinite resolution capability of continuous tone controls but removes all frequency and phase discriminating networks from the circuit when controls are on mechanical centre.

A Kit converts PAS-2 or PAS-3 to the new PAS-3X. **$15.70**

Write for a leaflet and see tone burst, square wave tests etc. and prove for yourself why you can never get better overall quality regardless of how much money you spend.

**AMPLIFIERS**

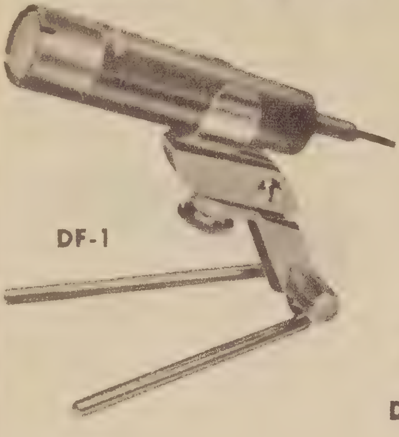
There are Dynakit amplifiers in all power brackets which will do justice to the perfectionist's pre-amplifier. All are rated for continuous power.
Dynakits for 60 watts rms per channel, 35 watts, 17½ watts etc.

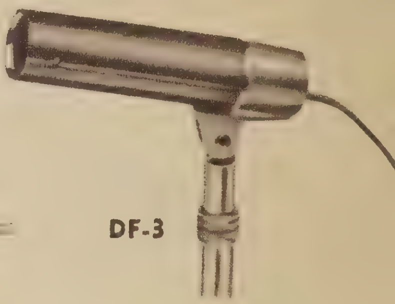
For other high quality amplifiers, radios, tape recorders, speakers or hi-fi components write for quote or call and listen in our modern showroom.

**B & O, S.R.T., Labcraft, Jobo, All-balance, Peerless, Clearway and other makes in stock.**

**DANISH HI-FI PTY. LTD.**
**66 MAYSTON ST., HAWTHORN**
**PHONE: 82-4839**
***N.B. Near CAMBERWELL Station in "The Hub."***

# foster dynamic microphones





50K ohms £5-12-0
50 ohms £4-18-6
Price Retail Plus Tax
Frequency Range
100-12,000 C/S.

50K ohms £2-14-0
50 ohms £2-5-7
Price Retail Plus Tax
Frequency Range
200-10,000C/S.

50K ohm £4-16-0
50 ohm £3-18-4
Price Retail Plus Tax
Frequency Range
50-15,000 C/S.

**ZEPHYR PRODUCTS PTY. LTD.**
70 BATESFORD ROAD, CHADSTONE, VICTORIA. — PHONE: 56-7231

AGENTS D. K. Northover & Co.—Neil Muller Ltd.—Homecrafts (Tas.) Pty. Ltd.—Jacoby, Mitchell & Co. Pty. Ltd.—T. H. Martin Pty. Ltd.—P. H. Rothschild & Co. Ltd., New Zealand.

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# Sure Brite Picture Tubes

ALL TYPES OF TUBES AVAILABLE EXCEPT BONDED

**Year Warranty**
**$10 plus dud**

**2 Year Warranty**
**$12 plus dud**

**Second Quality**
**$8 (See below)**

**27 inch $20 plus dud**
**All prices cash or COD**

THESE ARE
TRADE PRICES

**FULL WARRANTY:**
Any tube returned to Sure Brite under warranty is replaced with another one at no extra charge. regardless of whether it tests good or not, so long as it is not broken.

**COUNTRY CUSTOMERS**
Rail tubes to Lewisham Station, freight paid. Orders filled same day received. All freight charges to be paid by customer.

**LARGE STOCK**
We always have 200 to 400 tubes in stock. All Australian types except bonded. When ordering state which price tube you want, otherwise the $12 tube will be supplied.

**DELIVERY**
Free delivery on tubes Mon. Wed. Fri. inter suburbs only.

**SECOND QUALITY**
Some Second Quality Tubes at only $8.00

**DUDS**
Must be under vacuum and scratch free.
We can sell 17 inch without dud for $6 extra
21 inch without dud for $8 extra.

**TUBES**
We can supply tubes with 12 volt 300ma heater

# Sure Brite Picture Tubes

22A VICTORIA STREET, LEWISHAM, SYDNEY, N.S.W. PHONE 56-6363

# TRADE REVIEWS AND RELEASES

## Australian-made Oscilloscope

The oscilloscope pictured here is the model 500B general-purpose 5-inch instrument from B.W.D. Electronics Pty. Ltd. or 331-333 Burke Road, Gardiner, Victoria. It combines high sensitivity and wide bandwidth with convenience of operation and low cost.

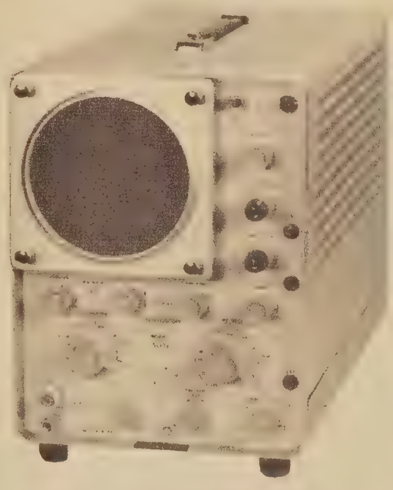
Intended for general laboratory use, the 500B incorporates a vertical amplifier having a basic sensitivity of 30mV/cM at a band width of DC-4MC(=3dB), and an input attenuator providing ranges down to 30V/cM in 1:3:10 steps. The risetime is quoted as 70 nanoseconds; a DC blocking capacitor can be switched in series with the input. An additional 10mV/cM range is provided at a reduced bandwidth of DC-2MC (=3dB). A vernier gain control is provided in addition to the preset "cal" control, permitting the sensitivity to be reduced to 100V/cM if required.

The amplifier itself employs five valves and provides balanced deflection. The attenuator input impedance is approximately 1M shunted by 50pF. A minimum of 10cM deflection is possible up to 1MC, and greater than 5cM at 5MC. An alternative version is available with differential input.

A calibration signal is available on the vertical sensitivity switch. A minor criticism here is that the amplitude of the signal is not shown on the front panel—one must refer back to the manual to discover (or rediscover) that it corresponds to a 4cM deflection.

The horizontal amplifier of the 500B has a bandwidth of DC-200KC (=3dB). It may be used for external signals, having an input sensitivity of 500mV/cM (which may be reduced to 10V/cM) and an input mpedance of 1M shunted by 100pF.

The timebase of the instrument consists of a Miller integrator driven by a bi-stable lip-flop. It may be operated in either free-unning or triggered modes to provide speeds of from 1uS/cM—500mS/cM approx. 0.2cps—100KC). Linearity is quoted as within 2 per cent at 10cM deflecion, and there is a continuously variable sweep expansion which gives an equivalent race width of at least 50cM up to a peed of 10uS/cM. The timebase output s available at the front panel from a ource of 1K impedance.



Synchronisation and triggering may be automatic at zero-crossings or adjustable in level, and from either positive-going or negative-going sections of the signal. HF and LF filters are provided for selective triggering or synchronisation; also available are positive and negative polarity mains-reference modes. External triggering signals may be applied, to a terminal having an input impedance of 1M shunted by approx. 30pF.

Positive-sense intensity modulation may be applied to the CRT by means of a terminal on the rear panel. A waveform of approx. 20V p-p will just produce trace cut-off on negative peaks at normal trace brightness. Input impedance for intensity modulation is 0.01uF and 15K.

Display on the 500B is bright and sharp, as a result of the 2500V total EHT applied to the CRT. Of this +1200V is applied to the post-deflection electrode of the tube and —1300V to the gun electrodes. Both supplies are produced via voltage multiplication circuits from the mains transformer. Spot astigmatism may be corrected via a front-panel control.

In appearance the 500B is quite attractive, in a two-tone grey lacquer finish. Front-panel layout is functional and convenient, and testifies to thoughtful design. About the only criticism we would make about the unit reviewed is that the panels which form the top, bottom and sides of the case are insufficiently fastened; this tends to detract from the attractiveness of an otherwise rugged but lightweight design.

The tube screen is fitted with a detachable graticule and green filter, and has facility for camera mounting. A tilting foot or "bail" is provided for convenient bench-top use.

In operation the instrument is straightforward and convenient to "drive"; its performance agrees quite closely with the manufacturer's specifications. Incidentally, the instrument conforms to Australian Standard Specification CPT/3, including Environmental Specification K114/D.

Cost of the 500B is quoted as $320, plus tax where applicable. The instrument was sent for review by the manufacturer, at the above address, and all inquiries may be directed to the manufacturer or to Watson Victor Pty. Ltd., their distributors in all States. (J.R.)

## "Windowfall" Test Proves Meter Durability

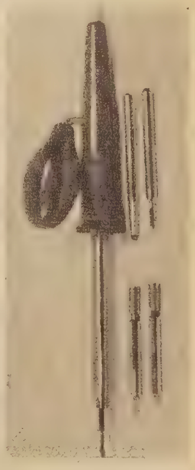
A recent addition to the Paton Instruments range is the Model C.P.4 flush mounted Milliammeter. This instrument ncorporates taut-band suspension and a Lexan" (Polycarbonate) clear plastic housng resulting in an extremely rugged instrument which will withstand a considerable mount of rough handling.

The C.P.4 is available in all the normal moving coil (DC) moving coil rectifier (AC), hermocouple (RF) and moving iron (AC) anges, and is interchangeable with the arlier bakelite housed model. It is also vailable with a special Lexan escutcheon or "behind the panel" mounting.

The ruggedness of the Lexan housing and taut-band suspension combination was proved dramatically in an incident which took place recently at the Paton Instrument's works. A series of controlled bump, shock and vibration tests had no effect on the instrument, so the test sample was deliberately thrown out from a first floor window, resulting in a drop of 20 feet on to a concrete footpath. Even after several such drops, the instrument suffered no major damage, and still functioned satisfactorily. (For further details, apply to Paton Electrical Pty. Ltd., 90-94 Victoria Road, Ashfield, N.S.W.)

## DE-SOLDERING TOOL

**ADCOLA PRODUCTS PTY. LIMITED** have recently introduced a new soldering tool on the Australian market. This new tool is based on the Adcola "M" series soldering iron and features a suction device for the removal of solder holding components terminated on printed wiring boards. A series of tips are available with the iron, some of which are for standard soldering, the others for the "de-soldering" function.



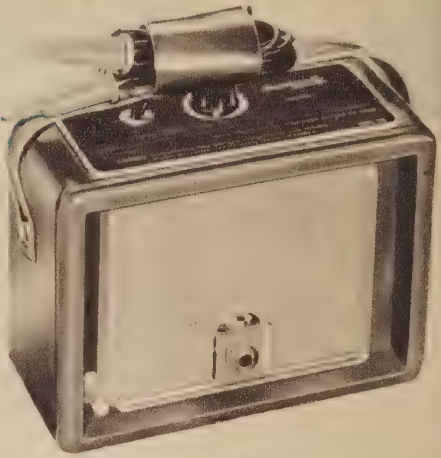
The de-soldering tips are hollow and stainless steel lined. When these tips are inserted in the barrel of the iron the centre tube is connected to a small plastic bulb attached to the handle. To remove the solder from a joint the bulb is first depressed by the forefinger and the tip then applied to the joint. When the solder reaches a liquid state, removing the forefinger from the bulb develops suction to draw the molten solder into the hollow tip.

The solder may then be ejected by depressing the bulb while holding the iron over a suitable container. We subjected a sample iron to a trial run in our laboratory and found it extremely convenient for working on printed wiring boards. We had reservations at first as to the danger of the molten solder being squirted out and causing an injury. However, this thought was soon dispelled as, even with deliberate attempts to squirt the solder, it travelled only a very short distance.

The de-soldering soldering tool, Cat. No. M207, is available in various operating voltages including 240V AC. Further details can be obtained from Adcola Products Pty. Limited, 12 Churchill Street, Mont Albert, E10, Victoria, or from Adcola distributors.

# 500V "UNIMEG"

## INSULATION TESTER



**RANGE. .25 to 50 megohms at 500 volts test potential, with centre scale at 3.5 megohms.**

One of the most common faults causing the malfunction or failure of electrical equipment is **insulation breakdown.**

The gradual deterioration of insulation over a period of time can be detected by regular inspection and testing.

A quick and efficient test of electrical equipment, appliances and electrical wiring can be made by using University Graham's "UNIMEG."

This ruggedised portable transistorised insulation tester used regularly will detect failures in their early stages thus preventing expensive breakdowns which could occur at inconvenient times. The unit consists of a stable transistorised oscillator the output voltage of which is then stepped up by a transformer and in turn converted to 500 volts DC by high voltage rectifiers.

The power is supplied by a 9 volt transistor radio battery and by the nature of the unit's intermittent operation and its reserve voltage, long battery life can be expected.

For more information on "UNIMEG" or any electrical measuring problem consult:—

**UNIVERSITY GRAHAM**
**INSTRUMENTS PTY. LTD.**

**106 BELMORE ROAD, RIVERWOOD, N.S.W.**
Telephones: 53-0644 (5 lines)
Telegraphic Address: "Raquip," Sydney

**THE "UNIMEG" IS QUICK AND SIMPLE TO USE.**

1. "Short" the test leads, press the push switch, and adjust the potentiometer, to indicate full scale on meter.
   **Note:** (The 500 volt potential is present only when switch is depressed.)
2. Connect test leads to circuit under test, and press push switch.
3. Read resistance directly off scale.
   Solid leather carrying case, with combined shoulder and hand strap, available as an extra.

**REPRESENTATIVES:**

W.A.: Atkins (W.A.) Ltd.,
894 Hay Street, Perth, W.A.

S.A.: George Procter,
52 Gawler Place, Adelaide, S.A.

VIC.: Eastern Instrument Services Pty. Ltd.,
38 Milton Parade, Malvern, SE4.

QLD.: Keith Percy & Co. Pty. Ltd.,
Box 1478V, G.P.O., Brisbane, Qld.

TAS.: W. P. Martin and Company,
188 Collins Street Hobart.
and 134 Cambridge Street,
Launceston.

AUSTRALIA'S LEADING MANUFACTURER OF ELECTRICAL INSTRUMENTS (A UNIT OF INSTROL)

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# AUSTRALIAN SOUND AND TV CO. PTY. LTD.

## 35-39 YARRA BANK ROAD, SOUTH MELBOURNE

**61-3024** **TELEGRAPHIC ASSOUND. MELBOURNE** **61-3192**

Manufacturers and designers of the most reliable commercial amplifiers available today. Any of our stock amplifiers will meet any standard Government Specification. Each individual amplifier is custom built. Our 250/300 watt units were selected for the Qantas project in Sydney in competition with American counterparts. All amplifiers can be purchased tropicalised.

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|---|---|
| 3/5W | **$42** |
| 12/15W | **$62.62** |
| 30/40W | From **$77.50** to **$83.97** |
| 60/70W | From **$98.30** to **$103.32** |
| 100/120W | From **$113.30** to **$117.66** |
| 250/300W | On application |

Complete with Hi Imp input and tone control Pick-up input and tone control, 100 V line out. Tax 12½% unless to be used for Music purposes then 25% 50 ohm input with Mu Metal transformer mounted on chassis—$15.25 additional.

Transistor amplifiers.

A.S.T.—5/12 W, **$28** to **$42** plus 12½% sales tax.

A.S.T. 30/40 W Guitar amplifiers, **$180** plus 25% sales tax.

A.S.T. Transistor amp 5W—V/C out **$28.**

A.S.T. Transistor amp 10W—V/C out **$40.**

Tax 12½%.

A.S.T. Radio tuners from **$10.**

DEMONSTRATORS P.A. SYSTEM

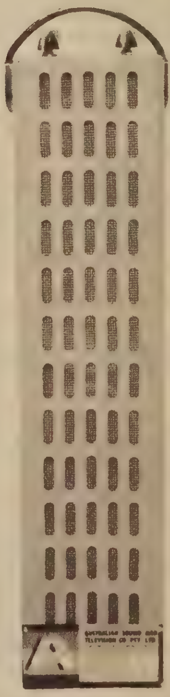
ITS

- Transistorised
- Will efficiently cover 500 people.
- Works off Torch Batteries
- Printed Circuit
- The most advanced self-contained P.A. System available

Can be supplied with Neck Microphone, Cardoid Microphone Telescopic Stand.

Price as per illustration
With Dynamic Microphone
$62.50. Tax $7.81

PACKING and FREIGHT EXTRA



# HIGH-QUALITY GOODMANS TWEETER

Of special interest to high fidelity enthusiasts is a new tweeter from Goodmans Industries Ltd., released in Australia through British Merchandising Pty. Ltd. of 60 Clarence St., Sydney.

The tweeter, as illustrated, is described by the manufacturers as a "dome lens multicellular" unit, identified as model D.L.M.2.

It appears to have a small metal diaphragm, which is virtually tamper-proof (and inspection proof) by reason of the riveted method of assembly. In front of the diaphragm, a shallow outer horn of moulded plastic, a system of vanes, and a central fluted metal dome, form what is virtually an 8-section horn to ensure good high-frequency dispersion.

Mounting provisions for the tweeter are very practical. Normal procedure is to cut a 4-3/16in diameter hole in the face of the enclosure; the protruding face of the tweeter passes through this hole, obviating any confining effect that the edge of the wooden baffle might otherwise have. Four screws, through the tubular assembly rivets, hold the speaker in position and virtually seal the hole in the baffle, against egress of low-frequency energy.

Manufacturers' ratings indicate that the unit will operate satisfactorily with systems delivering a power output of up to 25 RMS watts, the tweeter having its own built-in frequency limiting network. Voice coil impedance is nominally 16 ohms but the tweeter may be connected to lower impedance systems, if desired, without frequency unbalance, provided effective sensitivity is adequate for the particular system.

On listening tests in our laboratory, using tone and music, the general balance and response to the tweeter, on axis, was comparable with other modern tweeters of the conventional cone type. Sensitivity was of a similar order and while A-B tests showed some differences in colouration, these were of the order that one normally encounters between HF units of different design.

Where the D.L.M.2 does exhibit a clear departure in behaviour is in the region around 9KC and above, where the horn structure gives much better dispersion of the sound energy. This would be most significant in listening situations where all the audience cannot sit in an optimum position, or where high-frequency dispersion is not aided by hard surfaces.

Australian retail price of the unit is $24.60, subject to normal trade discounts. Not a cheap unit, perhaps, but a good one. (W.N.W.)

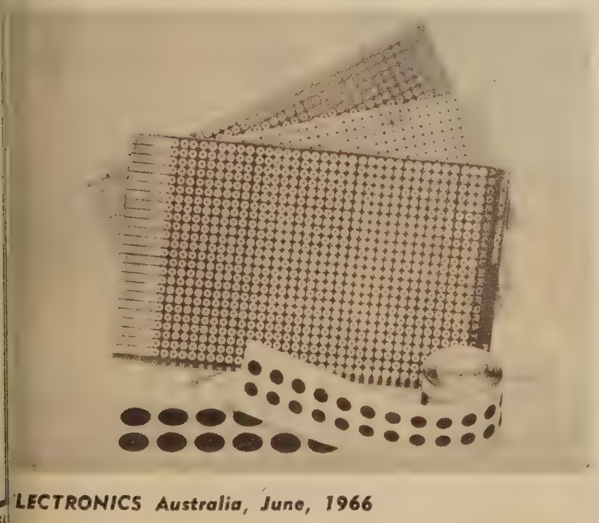
## PRINTED WIRING AIDS

**PRECISION WINDINGS,** of 52 Cambro Road, Clayton, Victoria, has sent further samples of printed wiring boards of their manufacture to ELECTRONICS Australia design, this time for the 3-band double-change receiver described in our April, 1966, issue. These are of excellent quality, and are recommended for readers undertaking the construction of this project. The samples received have copper resist on epoxy or glass base, but boards can be supplied on phenolic paper at lower cost, or with gold plate resist, if required.

Also received from Precision Windings are samples of items they can supply to assist in the preparation of artwork from which finished printed wiring boards can be made. Prototype construction boards can be supplied in the same range of finishes as stock boards, on phenolic paper, epoxy or glass base, with copper or gold plate. The boards have edge connections to match with commercially available connectors.

These boards have 34 rows of holes, with 24 holes to the row, spaced at 0.1in centres, corresponding to the spacing of graph paper with 0.1in squares, and coded along the edges to facilitate transfer of the layout to graph paper before preparing the final artwork on transparent film.

For making the actual artwork, Precision Windings provides various sizes of self-adhesive solder lands and black crepe tape, as well as transparent film. A leaflet describing the process of preparing artwork using these accessories is available from Precision Windings on request.



*The prototype printed wiring boards are coded along two edges to facilitate transfer of information to squared paper. Solder lands are supplied in rolls, in various sizes.*

# ILLUMINATED P.B. SWITCHES

**PLESSEY COMPONENTS GROUP** is making, in Australia and under licence from Illinois Tool Works Inc., of Chicago, U.S.A., a range of illuminated push-button switches, which are being marketed under the name Plessey-Licon 01 Series.

The new Plessey-Licon 01 Series has been introduced to cut control panel costs by combining indicating and manual switching functions in a single compact component.

Designed for commercial and military electronics equipment requiring highly reliable precision switching and where space requirements are critical, the Plessey-Licon 01 Series meets the MIL-S-22885 specification.

The push-button serves as the colour and/or legend indicator and can at the same time actuate one or more subminiature snap-action switches.

The basic switch employed is the Type 16 double break pattern which has proved capable of exceptional life with electrical loads of up to 10A per circuit. A number of contact configurations, plus indicator-only styles, provides a wide choice of control and indication possibilities. Momentary contact, maintained contact and solenoid-held versions are available.

In construction, the 01 Series consists basically of two parts: a switch and lamp-holder assembly, and a snap-on lens cap. For maximum life, the single lamp remains stationary when the button is pressed. S 6/8 or L.E.S. capped miniature lamps are standard and can be changed easily, without tools, from the front of the panel. A wide selection of round and square lens caps, in various sizes and colours, is available and the tough moulded caps can be supplied engraved with any required legend. There is a choice of two methods of illuminated display:

Solid Colour, where a brilliant opaque colour is visible both in the illuminated and unlit condition; and

Projected Colour, where a lens cap of frosted white in the unlit condition becomes illuminated by light projected through an internal coloured filter.

Plessey-Licon 01 Series push-buttons are available from Ducon Condenser Pty. Ltd., P.O. Box 2, Villawood, N.S.W.

KADAN
DESIGN ENGINEERS
MANUFACTURERS
INSTALLATIONS

40 WATT CUSTOM BUILT AMPLIFIERS FOR MUSICAL INSTRUMENT AND PUBLIC ADDRESS APPLICATIONS.

*All Transistor*

- 240v. Operation ● Weight 16lbs
- Dimensions 18in x 8in x 5in.

Only highest quality components throughout. Attractively styled vinyl covered cabinets. Standard models available for fixed or portable P.A., Guitar and other Musical Instruments.
P.A. features built-in mixer with up to 5 separately controlled inputs which may be chosen to suit individual requirements (mag. and Xtal, mic., P.U., radio, etc.).
Musical instrument models feature wide range variable and switched tone controls and vibrato.
Kadan Speaker units to suit include hi-fi columns of unique design specially suitable for natural reproduction of speech and acoustic instruments with excellent freedom from feedback effects.
Portable cabinets for electronic musical instruments feature pairs of Rola 12UX or 12UEG speakers and robust construction.

Phone for free quotations or free demonstrations evenings or weekends in Sydney area.

41-1294, 41-4375, 49-2878.
59 St. John's Avenue, GORDON, N.S.W.

# *Special Bargains from*
# RADIO HOUSE PTY. LTD.

### "SUNRICH" PORTABLE 5 TRANSISTOR TAPE RECORDER

**Model 999A $31.50 (£15/15/-)**

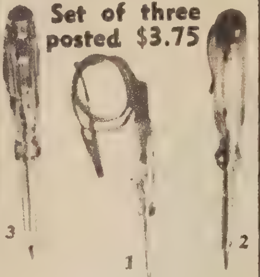
Plus post., 75c.

Reduced from £22/10/

Complete with Tape Battery Phone and Mike

### *SPECIAL PURCHASE*

**Set of three posted $3.75**



### CHROME VAN

German screwdriver and pocket tester.

1. 6-12 volt model auto tester.
2. Sparkplug tester.
3. 110-380 Volt mains tester.

**$1.25 each**

# MULTIMETER TESTERS

### Model RH-50

Modern Design, 33 Micro Amp Meter.

30,000 Ohms per Volt D.C.

13,000 Ohms per Volt A.C.

1 p.c. Multipliers and Shunts used. Printed circuit.

Clear Scale, rugged moulded case.

**SPECIFICATIONS**

DC Voltages: 0-0.3-1.2-3-12-30-120-300-600-1,200 V at 30,000 Ohms per volt.

AC Voltages: 0-3-12-30-120-300-600-1,200 V at 13,000 Ohms per volt.

DC Current: 0-.06-6-60-600 mA, 0-12 A.

Resistance: 0-60K-6M-60M (350, 35K, 350K at mid-scale).

Decibels: minus 20 to plus 57 dB (0 dB equals 1 mW. 600 ohms).

Audio Out: Capacitor in series with AC volt ranges.

Short Test: Internal buzzer.

Accessory: 1 pr. heavy test leads.

**Price $31 (£15/10/**

Postage 50c to $1 extra.

Batteries: 1 (1.5V), 1 (15V).

Size: 3 5-16" x 6 5-16" x 2

Weight: 1.4lb approx.

## LIMITED STOCK ONLY

### Model RH-10

**RANGES:**

DC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

AC Voltages: 0-10-50-500-1,000 V at 2,000 Ohms V.

DC Current: 0-500uA 0-500 mA.

Resistance: 0-10K-1 Meg: 60 ohms, 6 Kohms at centre scale.

Capacitance: 250uuF to 1uF, in two ranges.

Decibels:—20 to plus 36db, two ranges.

Output: 0-1,000 V in four ranges.

Size: 5in x 3½in x 1½in.

Weight: 13oz approx.

**Price $10.75 (£5/7/6)**

**Postage 50c to $1 extra.**

### Model RH-5

- High sensitivity-20,000 Ohms/V DC, 10,000 Ohms/V AC.
- 3in Meter.
- Handy pocketable size.

**SPECIFICATIONS**

DC Voltages: 0-10-50-250-500-1000 V (20,000 Ohms/V).

AC Voltages: 0-10-50-250-500-1000 V (10,000 Ohms/V).

DC Current: 0-50uA, 0-5-50-500mA.

Resistance: 0-10K, 0-100K, 0-1Meg, 0-10Meg. (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale).

Capacitance: 0.0001uF-0.005uF, 0.05uF-1uF.

Decibels: minus 20db to plus 36db in 2 ranges.

Dimensions: (3½" x 5½" x 1¾").

Weight: 15oz approx.

Complete with internal battery, testing leads with prods.

**Price $18 (£9/0/0)**

**Postage 50c to $1 extra.**

### PORTABLE TRANSISTOR TAPE RECORDER

**"SUNACE" PD 401**

**$21.00 (£10/10/-)**

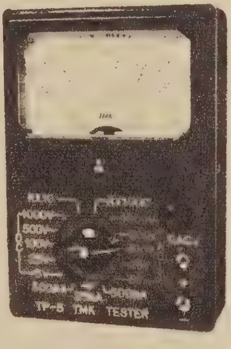
***Postage 75c (7/6)***

Complete with Mike, Battery and Tape.

### MODEL TP-5 POCKET VOM. TESTER

**RANGES:**

- DC Voltage: 2,000 OHMS per VOLT 0-5-25-100-250-1000 Volts.
- AC Voltage: 2,000 OHMS per VOLT 0-5-25-100-250-1000 Volts.
- DC Current: 0-500uA, 25uA, 500mA.
- Resistance: 0-20K, 0-2Mg. OHMS.
- Capacitance: 500uuF to 0.1uF at 100V AC. 0.01uF to 2uF at 5V AC.
- Decibels: minus 20 DB to plus 48DB in 5 ranges.



**£5-17-6**

**$11.75**

### CAR, CARAVAN LIGHT FITTING

Auto light with switch fits any car, plugs into cigarette lighter socket. 6 or 12 volt available.

**$3.75 Posted**

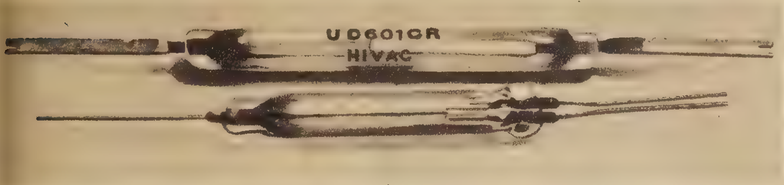
**SPECIAL OFFER**
**ALL TRANSISTOR MANTLE RADIO**
**$11.95 (£5/19/6) Postage 50c**

# RADIO HOUSE PTY. LTD.

**PHONE 26-2817**

**306-308 PITT ST., SYDNEY. Also at 760 George St. and 6 Royal Arcade.**

# New Components From Ducon



The Ducon Division of the Plessey Components Group advises that there are now two additional types of dry reed switch available in Australia. (See ELECTRONICS Australia, August, 1965 for discussion of dry reed switches.)

One of these, the XS11, is a changeover type mentioned in the article referred to above, but which has been in limited supply until now. The other version, type UD601/CR, is a recent release, being virtually a heavy duty version of the XS2.

The XS11, and a modified version, the XS13, are rated at a maximum switched current (for long life) of 200mA, a maximum switched voltage of 250, or combinations within these limits which do not exceed 10W.

The XS13 is identical with the XS11 in all respects other than the contact plating. The XS11 is partially diffused gold, the XS13 fully diffused gold. The latter form is particularly recommended where "dry" (no current) or low current circuit conditions may apply.

Both the XS11 and XS13 are available in two sensitivity ratings, designated as /1 and /2 in each case. The /1 has an operate ampere turns rating of 95 and the /2 of 120.

The UD601/CR uses a similar glass assembly to the XS2, but has longer terminals. Tentative data gives the maximum switched current as 3A, maximum switched voltage as 250 or combinations within these limits which do not exceed 75W (resistive).

The operate ampere turns are given as 100, while the operate and release times are similar to those for the XS2.

Technical data sheets, details of price tructure, etc., may be obtained by appliation on firm letter head to Ducon ivision, Box 2 P.O., Villawood, N.S.W.

Ducon is marketing in Australia the ange of Numicator tubes made in U.K. by ivac Ltd. These are neon digital display tubes which, says Ducon, will sell at an attractive price. Numicator tubes can be operated from mechanical or electro - mechanical switches, from cold cathode tubes, or from transistor circuits. Advantages claimed for the tubes are that they have low consumption and low-temperature operation, and are free from the risk of sudden failure. A feature of the tubes is their compact size, envelope dimensions being approximately 2in x ¾in.

Typical of the range is the Type XN3 Numicator lustrated) which is a side viewing in- ne display indicator for figures 0 to 9.

Another type, XN6, has characters +, -, 1, X, and is designed to give the fol- wing displays: + — +1, —1, 1. This be also contains an electrode which is obscured so that the Numicator drive circuit may be loaded without giving a display. The symbol X is intended to be used to signify overload condition, when it is displayed in addition to any of the combinations of characters shown above.

*ABOVE: Two new dry reed relays available from Ducon. BELOW: Encapsulated Neon indicator and mounting clip and two of the range of type DMA capacitors.*

·22MFD
250V DCW
3/66
Ducon
·1MFD
DMA
3/66

Other Numicator tubes available (with their symbols shown in brackets) are: XN2 (1 to 11); XN4 (½); XN7 (+ —); XN8 (1 and hidden electrode); XN9 (½ and hidden electrode).

Other Numicator tubes with special symbols can be supplied to special order.

Ducon has a limited number of technical brochures on Numicator tubes. Requests for these should be on company letterhead.

Ducon has stocks available of an encapsulated Neon indicator fitting for use as a panel-mounted indicator light. These are available in three colours, clear, red and amber, and in two voltage ranges, 100/120V and 200/250V. Since the assembly is totally encapsulated, it is completely waterproof. Ducon say it will withstand continuous ambient temperatures up to 70 degrees Centigrade. A single 8mm hole is required for mounting, the assembly being retained by a simple clip supplied with the unit. A leaflet describing the unit is available on request.

Ducon Division has released a new range of polyester dielectric capacitors, known as Type DMA. These are encapsulated in a silicone modified resin, resulting in a reduction in volume when compared with the existing range, which are encased in plastic sleeves.

Voltage ratings are now 160, 250, 400 and 630V DCW, which introduces an added rating of 250V DCW, to assist in design flexibility, Ducon says. The DMA range conforms to S.A.A. Draft Specification DOC 792 Category 755, and meets the requirements of I.E.C. Draft DOC.40/108 (Central Office) and amendments.

Inquiries for all the items mentioned should be addressed to Ducon Divisior Plessey Components Group, Box 2, P.O Villawood, N.S.W.

# TRANSFORMERS AND CHOKES FOR MULLARD AMPLIFIER

**A & R TRANSFORMERS PTY. LTD.** announce that they can supply a complete set of transformers and inductors for the Mullard-RCS "Twin-5W Class A Stereo Power Amplifier," as originally published in Mullard "Outlook" Vol. 8 No. 4 (July-August 1965) and described in adapted form in our own April 1966 issue. The power transformer is type PT5755 (20V-0-20V at 2A), filter inductor type Z3212 (18mH at 1.5A, 2 ohms DC), and the output inductors (2 off) type Z3200 (50mH at 1A).

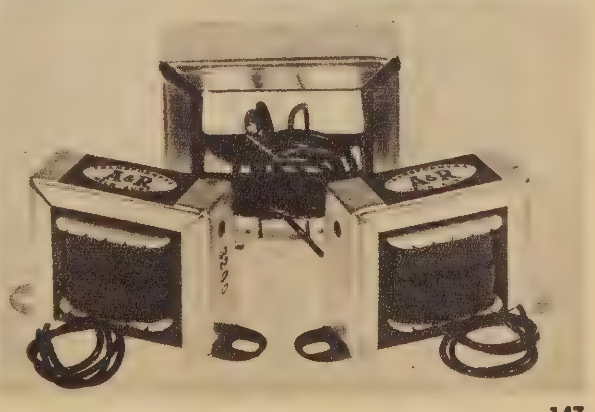
In announcing this set of components mention should be made of a certain amount of confusion which has lately arisen regarding the power transformer secondary voltage for this amplifier.

As originally described, the power supply of the design used R-C filtering, and because of the I.R. voltage drop in the filtering resistor the transformer secondary voltage was specified as 24V-0-24V to provide a final supply voltage of 22V.

However, subsequent experience has shown that to achieve a satisfactory hum level, it is necessary to substitute an inductor for the original filter resistor. Since the inductor has a lower DC resistance than the resistor it thus becomes necessary to reduce the transformer secondary voltage to 20V-0-20V, to ensure that the power transistors are not operated outside their dissipation ratings. This also allows the use of a less costly 25VW electrolytic capacitor in place of the 50VW type originally specified for the reservoir.

It may be noted that these modifications have been incorporated in the adapted amplifier described in our April, 1966, issue; and that the above components are fully compatible with the revised design.

A and R advise that the components are available through the usual trade channels. Prices from parts suppliers are quoted as follows: PT5755, $3.94; Z3212, $1.74: Z3200, $2.07.



*A & R power transformer and output chokes for Mullard 5W amplifier.*

**A. C. E. RADIO**

AMPLIFICATION · COMMUNICATION · ELECTRONICS

PHONE 51-3845

136 VICTORIA ROAD, MARRICKVILLE, SYDNEY,
AND 636 KING STREET, NEWTOWN—51-7008

# 136 VICTORIA ROAD, MARRICKVILLE — 51-3845

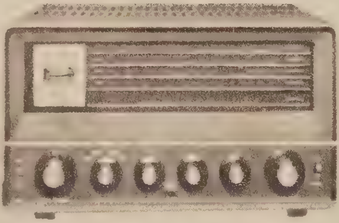
AUSTRALIAN DISTRIBUTOR **TRIO** ACCREDITED SERVICE DEPOT

# COMMUNICATION RECEIVERS TEST EQUIPMENT - AMPLIFIERS

WORLD FAMOUS COMMUNICATIONS RECEIVERS

*N.B.: ALL PRICES INCLUDE SALES TAX*

## J.R. 200 D.X. DELIGHT



7 Valve. 4 Band. 550 K.C. to 31 Megs. A.M. and C.W. Bandspread. A.N.L. B.F.O. A.V.C. M.V.C. S Meter. R.F. Stage. 240 V. 50 Cycle.

**$99.00 £49/10/-**

Also available in kitset $89.00 £44/10/-

## 9R. 59 AMATEUR SPECIAL

9 Valve. 4 Band. 540 K.C. to 30 Megs. Electrical Bandspread. Variable Selectivity. Q Multiplier. A.N.L. A.V.C. M.V.C. S Meter. B.F.O. R.F. 2-IF. Stable Osc. For SSB.

**$135.00 £67/10/-**

## J.R. 60 PRO-AM & S.S.B. V.H.F.

14 Valve. 5 Band. 540 K.C. to 30 Megs. Plus 142 to 148 Megs. Double Conversion. Electrical Bandspread. Variable Selectivity. Q Multiplier. A.M. C.W. SSB. F.M. Crystal Calibrator. A.N.L. A.V.C. B.F.O. Product Detector. Gated Beam. F.M. Det.

**$215.00 £107/10/-**

## TRIO STEREO AMPLIFIERS

### W-41U

9 valves. 20 watts. 20-20,000 cycles per channel. Input for tape. Mag. and crystal P.U.

**$110.00 £55/-/-**

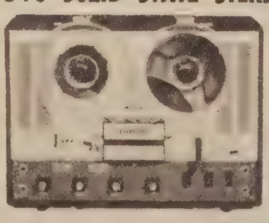
### WE-24

7 valves. 12 watts per channel. Input for tape. Mag. and crystal P.U. Direct coupled circuit. 20 to 20,000 cycles. Within ½ D.B.

**$95.00 £47/10/-**

## PAROS

### P310 SOLID STATE STEREO



14 Transistor. 6 Watts. 4 Track. 2 Speed 7½ x 3¾. 2 Diodes, 5 Thermistors. Freq. Res. 50 to 15K. 7" Reels. Complete 2 mics., 7" tape, 2 speakers.

**$195.00 £97/10/-**

### T.K. 400E SOLID STATE 26 TRANSISTOR 80 WATT STEREO

**240V A.C.** **40 WATT PER CHANNEL**

Inputs: Phono. Mag. 1½ MV, Tape 1½ MV, Phono. Cryst. 80 MV, Tuner 100 MV, Aux. 100 MV.
Freq. Res.: 20-20,000 plus/minus 1dB.
Controls: Bass, Treble, Loudness, Balance, Separation. $178 £89
VALVE TYPE, AS ABOVE, TK500E.
90 watt output.

**$170 £85**

## TRIO 2 METER OR 6 METER CONVERTERS

Locked crystal. Low noise cascode circuit.

**$55.00 £27/10/-**

## TRIO W.0.1 SWEEP GENERATO

TV and F.M. 2 to 260 Meg. Sweep 0 to 20 Meg. Ideal for TV Sound and Picture Aligning.

**$99.00 £49/10/-**

# TRADE RELEASES—IN BRIEF

**H. J. LEAK (AUSTRALIA) PTY. LTD.** has been formed as a joint venture by H. J. Leak Ltd., the U.K. manufacturers of high quality audio equipment, and their Australian associates, Simon Gray Pty. Ltd., who will continue as sole Australian distributors of the new company's products. The new company will manufacture in Australia products identical with those of the British factory, with the object of offering quicker delivery, better service and the export of Australian-made Leak products to South-East Asia and the Pacific areas.

The founder and chairman of the U.K. parent company, Mr H. J. Leak, recently visited Australia to assist in the launching of H. J. Leak (Australia) Pty. Ltd. Inquiries for Leak products should continue to be sent to Simon Gray Pty. Ltd., 26 Ridge Street, North Sydney.

**HERBERT OSBORNE PTY. LTD.,** of Melbourne, is selling in Australia a compact, portable petrol-driven electric generator manufactured by the Honda Motor Company, of Tokyo. The unit delivers 250V AC (50 or 60cps) or 12V DC and has a capacity of about 300W. The engine is a single cylinder four-stroke type, air cooled, with a piston displacement of 55.4cc which will run for about five hours on the tank capacity of 3.5 pints.

The Honda generator is said to be silent and free from vibration in operation, and safe to use, since all moving parts, the electrical circuitry and the exhaust muffler are fully enclosed, and the unit can be knocked over without risk of fuel spillage. Retail price is quoted as $185.95. Inquiries should be directed to Herbert Osborne branches in Melbourne, Sydney and Adelaide.

**PYE INDUSTRIES LTD.** recently announced details of a product guarantee plan for consumers which includes four years' free service. Giving details of the plan, Pye managing director Mr Peter Threllfall said the object was to inject confidence and stability into the Australian electrical industry. The plan was expected o stimulate increased demand in Australia for electrical consumer goods, to the benefit of Pye Industries, and their retailers and uppliers.

As well as free service, the plan provides complete product security to consumers who urchase anything in the Pye Industries ange of domestic appliances, radio and tereograms, TV receivers and dishwashers. This will include free replacement of any nit irreparably damaged, stolen or destroy-d, and cost of labour and parts over the our-year service period. The plan applies o goods invoiced after April 1, 1966.

**FERRIS BROS. PTY. LTD.** has released etails of its new Channel Master Super Color Crossfire aerial, Model 3617A.

This is a 28-element in-line aerial for V reception in all deep fringe, fringe nd difficult local areas, for all channels om 0 to 11. Eight tapered directors are used, each fitted with "folded whisker" phase controllers. Boom braces are fitted back to the mast either above or below the aerial. Aerials may be stacked for increased gain, or the all-channel "Telstar" amplifier may be used. The aerial is suitable for use with the Channel Master Rotator for multi-directional reception.

Retail price is given as $73. Prices of the various accessories are as follows: Horizontal polarised stacking harness, $10; Vertical polarised mounting kit, $19.50; 45-degree mounting kit, $12.20; Telstar amplifier, $39.90; Rotator, $66.

**PLESSEY COMPONENTS GROUP** has established a Connectors Division in Australia, based at The Boulevard, Richmond, Victoria. Manager of the new division is Mr Arthur M. Bennett, who was previously technical-commercial manager of Rola (Australia) Pty. Ltd.

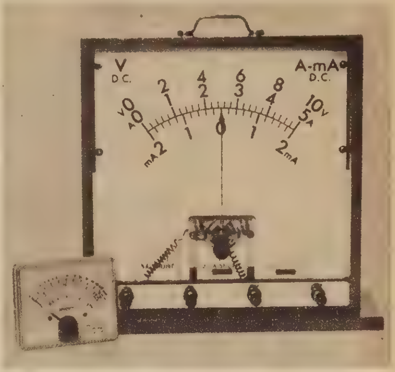
Interstate representatives will be located at existing Plessey premises, as follows: In N.S.W., Mr Graham Hall, Leightonfield Works, Villawood; in Queensland, Mr John Morris, corner Wedd and Fortescue Streets, Spring Hill, Brisbane; in Victoria, Mr Arthur M. Bennett, The Boulevard, Richmond; in South Australia, Mr F. Fryer, 246 Gilbert Street, Adelaide; in Western Australia, Mr Bryan Cortese, 248 Stirling Highway, Claremont.

**AUSTRALIAN GENERAL ELECTRIC PTY. LTD.** has given details of a new type of fluorescent lamp developed in the U.S.A. by General Electric, Cleveland, which is said to be revolutionary in concept. Known as a panel fluorescent, the lamp measures 12in square by 1½in deep and is said to have a light output equal to four 20W strip type fluorescent lamps. It has a face plate with 36 embossed square "bubbles" in a waffle pattern, the advantages of which are quoted as increased strength with light weight, good diffusion and decorative appearance. The back plate is of serpentine design, with six loops to compress a 62-inch arc stream into a 12in square source. Average face brightness of the Cool White type is quoted as 3,200 foot lamberts.

Inquiries should be directed to A.G.E. Head Office at 103 York Street, Sydney.

*A lighting arrangement using the GE panel fluorescents. Standard louvred fixtures are suspended below reflector boxes to utilise both down-light and up-light.*

**UNIVERSITY GRAHAM INSTRUMENTS PTY. LTD.,** of 106 Riverwood Road, Belmore, N.S.W., is manufacturing a range of demonstration meters for educational use (illustrated below). The unit has a large dial which can be easily read up to 45ft away, and scaled both sides for the convenience of lecturers. Front and back covers are made from specially treated Perspex to minimise electrostatic effects.



*One of the University Graham demonstration meters is shown here with a standard 4in rectangular meter for size comparison.*

These meters can be supplied with various scales, in single range and multiple range versions, and with or without diode protection. Full details and prices can be obtained from the manufacturers at the above address.

**H. ROWE and CO. PTY. LTD.,** has been granted sole Australian distributorship of the Electronic Service Co.'s electronic power drill speed controller referred to in a report in our Trade Review pages, February issue. Stocks are now held by all of H. Rowe's 26 sales branches throughout Australia.

**PYE INDUSTRIES LTD.** has entered the power distribution field by acquiring Gemco Pty. Ltd., Sydney-based manufacturers of busbars, power take-off boxes and lighting systems. The company will in future be known as Pye Industries Ltd., Gemco Division. Agencies are being established in all States for Gemco Division products and services.

**EMERSON AND CUMING, INC.,** of Canton, Massachusetts, U.S.A., have developed new adhesives, Eccoshield VSV and VSM, specifically for use with a flexible conductive gasket material of their manufacture, known as Eccoshield SV. The two adhesives will bond Eccoshield SV to itself or to metal.

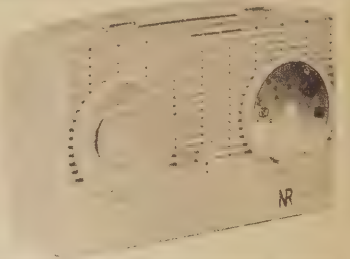
Eccoshield VSV for permanently bonding Eccoshield SV to itself is a one-part solvent based electrically conductive adhesive designed to give conductivity through the bond comparable to the conductivity of Eccoshield SV itself. It is useful for making continuous or ring gaskets from Eccoshield SV. Lap or butt joints may also be made.

Eccoshield VSM forms a permanent conductive bond between Eccoshield SV and metals, or many other materials. It is a two-part system containing solvent. Besides forming a highly conductive bond Eccoshield VSM can be thinned with solvent and used as a highly conductive surface coating for brush or spray application. The coating bonds well to metal, ceramics and many plastics.

Inquiries for these materials should be addressed to Wm. J. McLelland and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W., who are Australian agents for Emerson and Cuming products. ■

# Special Purchase of Manufacturer's stock of Transistors and Transistor Components enables us to offer Transistors and Kit-sets at a fraction of original cost.

## *Complete KIT for* TRANSISTOR 6 PORTABLE $21.95



The complete kit of parts for the transistor six includes six transistors, printed circuit board, coil kit, 4in speaker, Ferguson driver and output transformers, heavy duty battery and all necessary parts to complete the set with full instructions. **Set is housed in attractive plastic case as illustrated.**

Dials available for all States. Post and Pack: extra, N.S.W., $1.00, Inter., $1.30.

## NEW ENGLISH MAZDA TRANSISTORS

| TYPE | EQUIVALENT | | |
|---|---|---|---|
| XA101 | OC45 | R.F. Transistor | 55c |
| XA102 | OC44 | Osc. Transistor | 75c ea. |
| XB103 | OC75 | AUDIO general purpose | 75c |

Ducon type SFT 123 equiv, OC74 .. .. .. 75c ea.
Available in matched pairs at .. .. .. .. .. $1.50 pair
AUDIO OUTPUT
Post and packing on transistors 15c any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units $5.00. Deflection yokes $5.00. Post free

## NEW VALVES AT BARGAIN PRICES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1A7GT | 95c | 3S4 | $1.00 | 6J5 | 75c | 6SN7GT | 95c | 1L56 | 95c |
| 1C7G | 30c | 5Y3GT | $1.25 | 6K7G | 45c | 6SS equiv. 6SK7. | 85c | 12A6 | 50c |
| 1D8GT | 95c | 5V4G | $1.00 | 6K8G | 68c | 6U7G | 45c | 12SK7 | 50c |
| 1K5G | 40c | 6B8 | $1.00 | 6Q7G equiv, 6B6G | $1.00 | 6X5GT | 75c | 12SK8 | 50c |
| 1K7G | 49c | 6C8G | 50c | 6SA7GT | 95c | 7C7 | 35c | 12SH7 | 50c |
| 1M5G | 40c | 6F6 | $1.00 | 6SH7 | 55c | 12AU7 | $1.00 | 866 | 1.50 |
| 1P5G | 25c | 6H6 | 35c | 6SJ7 | 95s | 12AT7 | $1.00 | 954 | 25c |
| 1Q5G | 25c | | | | | | | 955 | 25c |
| 1T4 | 45c | | | | | | | 7193 | 25c |
| 3Q4 | 75c | | | | | | | EK32 | 68c |
| EF50 | 45c | | | | | | | EL33 | $1.00 |

Please add postage on all valves.

## NEW 4-SPEED STEREO & MONO PLAYERS

### AT LESS THAN HALF PRICE

PHILIPS 4-SPEED
6V BATTERY PLAYER
MONO $9.75
STEREO $11.75

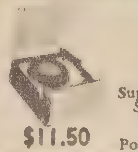
Post and Packing, N.S.W., 75c.
Post and Packing, Inter., $1.25 Extra.

## NEW 240V. ELECTRIC MOTORS

3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3½, including spindle.

$2.75

### NEW PORTABLE RECORD PLAYER
### CASES TO SUIT THE ABOVE TURNTABLE



Attractive two-tone cabinet with plastic trim. Supplied with 5in x 7in speaker in felt-lined enclosure Space for amplifier and batteries or power supply.

$11.50

Dimensions: 15in x 13in x 7in.
Post and Packing: N.S.W., 90c; Interstate, $1.20.

## NEW MULTIMETER—$5.25

POST EXTRA
METER 0-1MA 1,000 OHMS PER VOLT
A.C. RANGES D.C. RANGES CURRENT
SUPPLIED COMPLETE WITH TEST LEAD
RANGE 0-100,000 OHMS

| | | | |
|---|---|---|---|
| 0—10v | 0—100v | 0—500v | 0—500MA |
| 0—50v | 0—10v | 0—1000v | |
| 0—250v | 0—50v | 0—1MA | |
| 0—500v | 0—250v | 0—100MA | |

### EXTENSION SPEAKERS

New 9 x 6 speakers in case.
Post: Interstate, 55c; N.S.W. 40c.

### NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping Sec. 285 x 285 with 6.3v filament winding. 60mA, $2.50. Plus Postage: N.S.W., 35c; Interstate, 52c.

Prim.: 240v, Sec. 385 x 385 at 80mA, fil. 6.3 and 5v, $2.75. Post.: N.S.W., 40c; Interstate, 75c.

60mA H.T. Chokes, 75c. Post.: 20c.

### SHOP-SOILED 60 M.A. TRANSFORMER

285 x 285
One 6.3 volt winding $1.50 each plus post. N.S.W. 50c, Interstate 60c.

P.M.G. PRESS TO TALK HAND SETS, $2.50 each.
Post and pack 30c.

## T.M.K. MULTIMETERS

Before buying see our range of T.M.K. test instruments. As advertised in April issue of Electronics Australia.

### NEW MIDGET POWER TRANS.

40mA prim., 240v. Sec 225 x 225 with 6.3v. Fil. Winding.

$2.75 Postage: N.S.W.., 25c; Interstate 45c.

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil. Winding.

$2.75 Postage: N.S.W., 25c. Interstate 35c.

### TRANSISTORISED SIGNAL INJECTOR, $5.50

A MUST FOR QUICK TROUBLE SHOOTING
Using TWO Transistors, complete with instruction sheet and battery. Post free.

### NEW PER-MAG SPEAKERS by Australia's leading Manufacturer

| | |
|---|---|
| 6in Per Mag | $3.50 |
| 3½in Per Mag | $2.25 |
| 5in Per Mag | $2.75 |
| 5in x 7in Per Mag | $3.25 |
| Post and Pack, 35c N.S.W.; Inter., 45c. | |
| 6in x 9in Per Mag | $3.75 |

| | |
|---|---|
| 3½in Per Mag Tweeter with Cross Over Condenser | $2.00 |
| 6in x 9in Per Mag Hvy. dty. 15 ohm | 4.25 |
| 8in Per Mag. | $3.75 |
| 10in Per Mag. | $4.75 |
| 12in Per Mag | $6.75 |
| 12in Per Mag 20 watt | $13.50 |

Post and Pack, 50c N.S.W.; 75c Interstate.
12in Per Mag .. $6.75. Post and Packing, 75c N.S.W.; $1 Interstate.
Speaker Transformers for above 6T, 5T or 7T $1.00.

# NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE 56-7398.

# RESISTORS, CONDENSERS AND POTENTIOMETERS

**We have purchased the resistor and condenser stock of manufacturers including S.T.C. and Stromberg-Carlson who have ceased the manufacture of television and radio receivers and can offer same at less than 25 per cent of list price.**

The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg. in ½, 1 and 2 watt ratings and include some wire wound resistors. List price, $9.00 per 100. **Our price, $2.00 per 100.** Post and packing 25c extra.

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. List price, $11 per 100. **Our price, $2.06 per 100.** Post and packing, 35c extra.

The potentiometers are all current types and include switch pots, dual concentric and T.A.B. pots. List price, $12 per dozen. **Our price, $2.50 per dozen.** Post and packing, 25c extra.

***FREE*** For a limited period with each lot of resistors, condensers or potentiometers purchased we will supply free: One New Valve Type 6U7G, 6X5GT or IT4 as advertised on this page.

## Imported National Transistorised Shoulder Megaphone

These shoulder megaphones manufactured by National Radio Japan have an output of 4 watts, and are supplied complete with inbuilt horn type speaker, batteries and microphone. List price $78.

**Special Price $50. Post extra.**

**Other types also available.**

## NEW AMERICAN TWIN TELESCOPE TV AERIAL

Extends to 36in each section can be used singly for car or portable .. .. .. .. $1.50

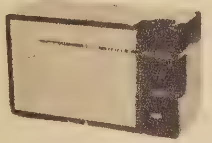
Post 20c.

## NEW 4" EXTENSION SPEAKERS

**These 4" speakers are mounted in polished cabinets suitable for use as intercom. units or extension speakers.**

**LIST PRICE .. .. .. .. .. $12.**

**SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT $4. Post and packing, N.S.W., 68c. Interstate, 98c.**



## NEW GARRARD RECORD CHANGERS

**These New English Garrard Changers with High Fidelity Crystal Pick-ups and Sapphire Styli have just been superseded. We are selling some at LESS THAN HALF PRICE. Available in STEREO at $25.50. POST AND PACKING EXTRA, N.S.W., $1.50; QLD., VIC., TAS., $2.25; W.A., S.A., $1.30.**

## HIGH-SPEED 240V. AC/DC MOTORS

These 240 v. a.c. or d.c. motors are 1/8 H.P. with a speed of 7.000 R.P.M. and are ideal for small drills, grinders, etc. Dimensions, 5½in x 3½in, with 5/16in spindle .. .. .. .. .. .. .. .. $3.75

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The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

**● 3-speed 1⅞, 3¾, 7½. ● Pause control. ● Takes 7in. spools.**
**● Simplified controls, 4 Track, $48; 2 Track, $44. OSC Coils, $1.50**

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**These new 3-speed B.S.R. Decks are fitted with a digital counter and will take 7in spools.**
**2 Track, $35.50. 4 Track 45.25.**

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23 RANGES. 240V. A.C. powered.

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A.C.V. 1.5, 15, 50, 150, 500, 1,500.
D.B. —10db to +60db.
Resistance. 1 ohm to 1,000 megohm.

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25 Watt by Rail or Air. Too Heavy, for Post.

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The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms.

The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/extra.

Inputs provided for microphone, pick-up, and radio with mixing facilities and tone control.

The 15 watt is as above but using two 6BQ5 valves in push-pull output.

| | | |
|---|---|---|
| **12in speaker for above (10 watt)** | **$6.75** | **67/6** |
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|---|---|
| Low frequency cut-off | 350 Hz |
| Sound distribution | 120 deg |
| Air column length | 350 mms |
| Power rating | 6 watts |
| Watts peak | 15 watts |
| Impedance | 16 ohms |
| Frequency response | 350 ÷ 10000 H |
| Maximum diameter | 210 mms. |
| Maximum length | 210 mms. |
| Weight | 1,300 grs. |

Price Retail £12-16-0
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| | |
|---|---|
| Low frequency cut-off | 220 Hz |
| Sound distribution | 90 deg. |
| Air column length | 550 mms. |
| Maximum diameter | 315 mms. |
| Maximum length | 365 mms. |
| Weight | 1,500 kgs. |
| Power rating | 18 watts |

| | |
|---|---|
| Watts peak | 35 watts |
| Voice coil impedance | 16 ohms |
| Frequency response | 120-7,000 Hz |
| Maximum diameter | 82 mms. |
| Maximum height | 68 mms |
| Weight | 1020 grs. |

Complete with accessories fo
application for line transformer

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| Low frequency cut-off | 150 Hz |
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| Air Column length | 915 mms. |
| Maximum diameter | 445 mms. |
| Maximum length | 540 mms. |
| Weight | 4 kgs. |

It may be supplied also without cover-hood for fitting the driver unit model 2545 TS.

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|---|---|
| Power rating | 25 wat |
| Watts peak | 45 wat |
| Voice coil impedance | 16 oh |

Built-in line matching transforme
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Watertight construction
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# AMATEUR BAND NEWS AND NOTES

## Australian Amateur Satellite for 1966

It is expected that before the end of 1966 the first artificial earth satellite designed and built in Australia will be placed in orbit.

### By Pierce Healy, VK2APQ*

Following discussion on an agenda item ıt the 30th Federal Convention of the Vireless Institute of Australia, work car-ied out by members of the Melbourne Jniversity Astronautical Society and the Aelbourne University Amateur Radio Club, t now seems certain that an Australian-uilt satellite will be completed and launch-d much sooner than had been expected.

With financial assistance from the W.I.A., nembers of the University societies will be ble to procure special types of transistors eeded for the radio equipment to be in-talled in the satellite.

Australia-wide coverage was given on ıpril 14 in the Press and by radio and elevision news services to the project, when statement was issued that:—

An earth satellite designed and built by ıustralian amateur radio operators has been pproved for launching in the United States t the end of this year. This will be the rst Australian-built satellite.

Called Australis, the satellite will be at n altitude of 500 miles and will orbit ıe earth every 1 hour 42 minutes.

The Australis project is being conducted y the Wireless Institute of Australia, the Ielbourne University Astronautical Society, ıd the Melbourne University Radio Club. hese three bodies have formed a joint ommittee to manage the project. Negotia-ons have been going on for several months ith project OSCAR, the American Ama-ur Radio Satellite Organisation which ıs built and launched four amateur radio ıtellites in recent years.

The Wireless Institute of Australia is ving the Australis project its full support ıd has agreed to contribute towards the ost of the satellite. The Department of ıpply has offered the use of its test facili-s in Melbourne and Salisbury, S.A., to st the satellite before it is shipped to the nited States for launching.

The Australis will weigh 35 pounds and ill measure 12 inches by 17 inches by inches. It will be powered by chemical tteries and will operate for about three onths. It will, however, remain in orbit r several years.

The objectives of Australis are to test uipment which may be used in later ıstralian amateur radio communications tellites and to gain knowledge of the oblems of building electronic equipment ıt has to operate in a space environment.

Work is well advanced on the flight odel of the Australis and it is expected ıt the satellite will be finally tested and ipped to the United States for launch-before Christmas.

Australis will carry four basic systems i.e. (1) An eight-channel link will relay data on temperature, voltages, and pressures inside the satellite to amateur radio operators around the world. It will transmit in the 144 to 148MC amateur radio band. (2) A tracking beacon operating in the 28MC band will be used by amateurs throughout the world to study radio propagation and to establish when this band can be used for intercontinental contacts. (3) The satellite will carry a radio receiver operating in the 144 to 148MC band which will accept command tones transmitted to the satellite by amateur stations around the world. The satellite's telemetry system will then acknowledge these commands. This will allow the command system to be tested so that later satellites can be turned on and off to conserve power. (4) Australis will carry a magnetic attitude stabilisation system so that one axis of the satellite can be aligned along the earth's magnetic field. This will have the effect of reducing the tumbling motion of the satellite as it orbits the earth. This, in turn, will mean that the satellite will transmit steadier signals back to ground stations.

*A full scale model of "Australis," the amateur satellite now under construction in Melbourne. The black and white bands are part of the temperature control system.*

With a successful launching of the Australis, Amateur Radio in Australia will have made yet another major contribution to the science of radio communications.

**lews and notes of Divisional and Club tivities, submitted for inclusion in ese columns should be forwarded ect to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.**

## WIRELESS INSTITUTE ACTIVITIES

The thirtieth Federal Convention of the Wireless Institute of Australia was held in the conference room of the Brisbane City Council Electricity Department in Albert Park, Brisbane, over Easter weekend April 8 to April 11, 1966.

It was 30 years since a Federal Convention of the Institute had been held in Queensland. Then, at 8.30 p.m. on Saturday, January 25, 1936, the 12th Federal Convention was opened in Brisbane by Mr E. T. (later Sir Ernest) Fisk, managing-director of A W A, over stations 2CH Sydney and 4BC Brisbane.

On that occasion, Mr Fisk was introduced to listeners by the Federal secretary, Harry Caldecott, VK2DA, from station 4BC, with Mr Fisk speaking from 2CH in Sydney.

The broadcast created history in the annals of amateur radio in Australia and some of the policy decisions made at that convention have materially assisted in the growth and status of the institute as it exists today.

The delegates to the 1966 convention were welcomed by the Federal president of the W.I.A., Max Hull VK3ZS, and the president of the Queensland division, Lawrie Blagbrough, VK4ZGL.

In his opening address the Federal president said:

"The W.I.A. has represented all amateurs in Australia for over 30 years, irrespective of whether they have been members of the Wireless Institute or not.

"We have fought valiantly for the conditions that exist today and, as the years go on and as we grow larger we still have to fight to preserve our frequency bands and to achieve better conditions for the internationally recognised amateur service in this country.

"Two of the major things that we will be discussing during the course of this convention, and which I consider to be of most importance for the amateur service in Region 3, in which Australia is situated, is the Federation of the Wireless Institute of Australia and the probability of holding, within the foreseeable future, a Region 3 conference.

"We are growing so large now that the pressures from commercial frequency users is increasing to a point where amateur service representatives all over the world are awaking to the fact that we will have to exercise an intensified degree of activity to preserve our amateur frequencies against the pressures from commercial frequency users, in particular the younger countries who are now taking an interest in western procedures such as communications."

The representatives of Federal executive and divisions attending the convention were:—

Max Hull, VK3ZS, Federal President.

Harold Hepburn, VK3AFQ, Federal Vice-President.

Peter Williams, VK3IZ, Federal Secretary.

Pierce Healy, VK2APQ, Federal Councillor N.S.W. Div.

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David Portley, VK4DP, Federal Cou cillor Queensland Div.

Lawrie Blagbrough, VK4ZGL, Observ Queensland Div.

Peter Brown, VK4PJ, Observer Queen land Division.

Geoff Taylor, VK5TY, Federal Cou cillor S. Aust. Division.

Roy Chamberlain, VK6RY, Feder Councillor W. Aust. Division.

Ted Cruise, VK7EJ, Federal Councill Tasmanian Division.

A total of 23 hours were spent arou the conference table. In addition ma more were spent in informal discussi among delegates, often extending into t early hours of the morning.

As foreshadowed in the President's ope ing address, the major items discussed we the proposed new Federal Constitution, a the necessity to promote the formation of Region 3 Conference.

In the discussion on the proposed ne Federal Constitution, the major points ra ed were the voting power and the protecti of the assets of individual divisions.

Under the present Constitution, each di sion has equal voting power and the Feder Organisation is an unincorporated body.

When considering the proposal to form corporate Federal body, the New Sou Wales Division, having the largest me bership and assets, proposed that the voti power be that of the membership of ea division.

This proposal was unacceptable to t smaller divisions, Queensland, South A tralia, West Australia and Tasmania, w have expressed the fear that they would completely dominated by the vote of combination of the Victorian and N South Wales Divisions. A similar view expressed by N.S.W. that with equality voting, matters relating to finance and poli could be determined by the vote of divisi having a substantially smaller number members. The Victorian division have in cated that they will agree with a propo with which all other divisions agree.

The problems associated with a mat such as this can only be fully apprecia by those who have seriously endeavou to find a solution.

Following many hours of discussion the subject, delegates at the 1966 Conventi formulated a proposal for consideration all divisional councils. The proposal gi Queensland, South Australia, West Austra and Tasmania four votes each, Victoria f votes and New South Wales six votes.

The proposal is based on the followi scale:

0 — 50 members 1 Vote
51 — 100 members 1 Vote
101 — 200 members 1 Vote
201 — 400 members 1 Vote
401 — 700 members 1 Vote
701 — 1000 members 1 Vote
1001 — 1500 members 1 Vote
1501 — 2000 members 1 Vote

For each thousand thereafter 1 V

It was also recommended that there a minimum of four votes for any divis and the number of members determined the number of "Full" members of a divis as at the January 1st, in the year in wh a vote is taken.

This is the first time in the history of Institute that the principle of proportio representation has been accepted by Federal Council of the Institute.

In relation to protection of assets each division, it was agreed that u acceptance of the proposed constituti each division would enter into an agreem with each other and the Federal body the effect that: no alteration shall be made to the articles, or resolution passed, that will enable the Federal Company to have any rights over the assets of any division or alter the voting power of each division, without the consent of each division being first obtained.

The necessity for the formation of a egion 3 conference within the framework of the International Amateur Radio Union nd the urgent need to ensure that finance s available for the W.I.A. to be represented t any conference dealing with amateur requency allocations, received the full support of delegates.

Federal Executive has been instructed o submit for consideration by divisions, ecommendations for financing representaion at a Region 3 conference.

A resume of the discussions that have aken place between officers of the Postnaster General's Department and members of Federal Executive, dealing with the revision of the "Handbook for Operators of Radio Stations in the Amateur Service" was given by the Federal vice-president Harold lepburn.

From the information tabled it is quite lear that a far greater degree of mutual greement and understanding of each other's oint of view than ever before, has gone nto the rewrite of the handbook.

This fact is clear from an extract taken rom the Federal president's report:

"There has been the necessity to give a ittle as well as take but the net result will e a handbook devoid of many of the ambiuities and unrealistic restrictions which ave 'bugged' the amateur service for many ears."

Dealing with the subject of contests orgaised by the Federal Contest Committee it as decided that a new formula as published the December 1965 issue of the nstitute's magazine, "Amateur Radio," ould be used for the 1966 Remembrance Day Contest.

In relation to the VHF contest for the oss Hull Memorial Trophy, it was agreed at the winner would be decided on the ore for the best seven days, not necessarily onsecutive days.

It was also agreed that the Contest Comittee give consideration to holding a local one contest within Australia.

The Federal president's report covered ght foolscap sheets and gave a very detaill coverage of the Federal Executive actities, as well as several facts regarding the essures from commercial interests on the orld amateur frequency bands.

In addition to giving details of the memership of the various Divisions, where in l except one there had been an increase membership, the latest figures of licences ithin Australia were stated as follows:

| Division | Full Licensees | Limited Licensees | Total |
|---|---|---|---|
| .S.W. ...... | 1331 | 348 | 1679 |
| ic. ......... | 1106 | 429 | 1535 |
| d. ......... | 496 | 144 | 640 |
| A. ......... | 488 | 192 | 680 |
| .A. ......... | 260 | 107 | 367 |
| s. ......... | 127 | 54 | 181 |
| tal ........ | 3808 | 1274 | 5082 |

The report stated:

"From the above figures it will be noted at the limited licensees comprise near ough to 25 per cent of the total licences ued. If the decline of applicants taking e morse code test for the "Full ticket" oceeds at the present rate I can only see ave danger ahead for the retention of the nds between 3.5MC and 30MC."

"The statistics kept by the Executive show at the licensee figure has doubled itself om 1948 to 1965. For the past 12 years it s increased at a steady rate of approxitely 200 per year. On this basis we can sonably forecast a total of 7,000 licensees 1975. A novice licence could cause a eper gradient on the graph as did the roduction of the limited licence in 54."

It is of interest to note that the requirents for a Novice licence as issued in ny countries do require the applicant to sit for a test in morse code but at a slower speed than that for the "full ticket." This requirement has also been included in submissions made to the PMGs Department by the Institute for the issue of the Novice Licence.

The concluding portion of the report made reference to the necessity for keen support by members towards activities associated with representation of the Amateur Service at the International Telecommunication Union level and quoted several statements made by Herbert Hoover, jun., president of the International Amateur Radio Union, on the subject.

Credit was also given for the work done by ex. officio officers and members of the executive in the past year.

Reports also presented to the Convention were from the Publications Committee, Federal Contest Manager, Federal Awards Manager, SWL Awards Manager, Federal Historian and QSL Bureau Manager. Following on last month's article on QSL Bureaux, it is interesting to note that the number of cards handled through the Federal bureau for 1965 totalled 57,393 compared with 49,986 for 1964.

These reports give an indication of the enormous amount of voluntary service which goes into organisation and operation of the Institute.

An invitation is extended by Federal Executive, Federal Council and all Divisional officers, to these amateurs who are not already members of the Institute, to join and strengthen still further the status of the amateur service.

### NEW SOUTH WALES

The adjourned annual meeting of the New South Wales Division of the W.I.A. was held prior to the April monthly meeting at Wireless Institute Centre, 14 Atchison Street, Crow's Nest, on Friday 22nd.

The meeting had been adjourned to enable the auditor to present his report and balance sheet for 1965-66.

The report indicated a stable state of affairs in regard to the financial position of the division. The auditor answered a number of questions asked by members on various aspects of the activities of the division.

A hearty vote of thanks, carried by acclamation, was passed thanking Mr R. Isserwood for help he has given to the division as auditor.

When closing the annual meeting, the retiring president Ivan Agar, VK2AIM, expressed his appreciation of the honour associated with the position of divisional president and his hope that he had satisfactorily discharged the trust placed in him over the past 12 months.

He also commented on the help and friendship which had been accorded him by all sections of the Division, in both city and country areas. In particular, he referred to the handful of good souls who, year after year, carry out their duties cheerfully, efficiently, and without direction."

Finally, he made an appeal to committee members, on behalf of the incoming president. The basis of this was to avoid procrastination; to get on with the jobs which had to be done, without the need for the president to be continually checking that they have been done.

He then invited Tom O'Donnell, the incoming president, to take the chair.

The guest lecturer for the monthly meeting was Bob Barringer, VK2ZIB, who gave a most enlightening lecture on the use of various types of relays.

The lecture was well illustrated with slides showing circuit details and installations. A large number of relays as well as some pieces of operative equipment, including a model of a relay operated beam controller and indicating device, fully demonstrated the uses to which relays can be put. The use of bridge circuits using diode rectifiers was also covered by the lecturer.

The business portion of the meeting, a report by the Federal Councillor, Pierce Healy, VK2APQ, on the Federal Conven-

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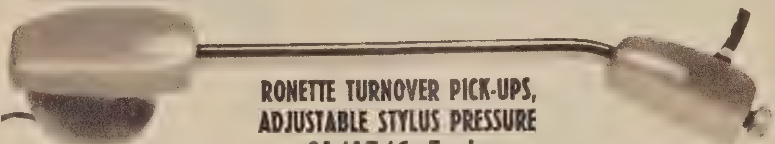

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Each kit set includes valves, speakers and all components.

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Ideal to use with the above amplifiers.

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| 3½ inch 47 ohm .......... | £1 0 0 |
| 6 x 4 33 ohm ............ | £1 5 0 |
| 2 x ½, 15 ohm ............ | £1 0 0 |
| 5 x 3, 47 ohm .......... | £1 0 0 |
| 5 x 3, 27 ohm ............ | £1 0 0 |
| 10 x 3, 15 ohm .......... | £1 10 0 |

Mini cable, 4 strand shielded, lots of uses, including microphone cable, extension speakers, etc. ...... 1/ yard

Radio knobs, push on ........ 5/ doz.

Miniature valve sockets 7 and 9 pin 1/ each

Octal valve sockets .......... 1/ each
National power transformers 6.3 and 225 a side ............ £1 5 0

Picture tubes, all sizes, new in cartons. **£12/10/.** With your dud. Bonded extra.
Philips IFT's 255KC ...... **7/6 each**
Aerial and oscillator coils .. **5/ each**

Scope soldering iron, standard; mini scope. Scope De Luxe. Vibra scope; National scope transformer.

## TV AERIALS

Famous Make

All types **£1/15/** to **£10** plus post.

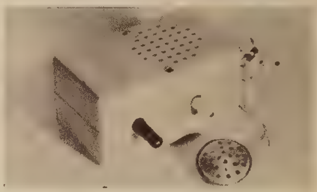
TV aerial lead in ............ **9d** yard

TV aerial chimney mount kits **£1 15 0**

Wall stand-off brackets, pair **19 0**

TV tuner biscuits, Philips, 12 mixed, bag .............. **£1 0 0**

## TELLY MINI TAPE RECORDER



**Specifications**

Record and play back, push-button controls. Playing time 30 secs. Batteries 2, 3v. Dimensions 3 9/16in x 2 3/16 in x 1 7/8in. Transistors 4. Reel endless. 1 3/8. Speaker 1 3/4. **£6/10/.**

## PUBLIC ADDRESS SPEAKER HOUSING

For 4, 5, or 6in speakers. **£2**, post **5/.**

2 amp fuses. ...... **£1 15 0 per 100.**

Special....12in speaker, 2 ohm Rola, **£3**, pack and post, **7/6.**

Transistor plastic outer case .. **5/ each**

Transistor carrying straps .... **2/ each**

Stereo pick-up arms, with Xtal.. **£3 each**

Metal rectifiers for battery and electric portables ........ **5/ each**, post. **1/**

Pilot lamp holders. ........**3/ per doz**

TV or cabinet castors........**4 for 10/**

100 Mixed Knobs including TV channe changers .......................... **£**

TV choke 250 ma **10/**, pack, post **3/**

240 v AC Record Changers, stere **£10/15/**, **Mono £10.** Pack and post N.S.W. **15/**, interstate **£1/5/.**

Gramophone motor and pick-up, 240 AC **£5/15/.** Pack and post, N.S.W **10/.** Interstate **15/.**

23in picture tubes, new, with slight spo burn, o.k. for testing, etc. **£5 eac**

OA 70 diodes ..............**4/ each**

Morganite and IRC resistors. At leas 33 values. Suit transistors, radios, TV etc., **£1 per 100. Pack and post, 2/**

3, 5, and 10 Watt IRC wire woun resistors. Many values.
.............. **2/ each, 12 for £**

100 mixed condensers, micas, ceramic tubular. Fresh stock.
............ **£1.** Pack and post **2/**

Electrolytic condensers. 3 in one.
50, 50 50mf 350vw 400 pv **15/ e**

50 + 24, 350 vw + 100 mf 25vw, **7/6 e**
30, 30mf 300 vw 350vp........**7/6 e**
Many others. Invaluable for service.

tion at Brisbane, was preceded by a showing of candid camera shots taken at the convention by Keith Howard, VK2AKX, who attended as observer.

The report covered the main points discussed, and included the decisions made on the amendments proposed by the N.S.W. Division to the draft of the new Federal Constitution. Many questions were answered and some points of the report elaborated. A very complimentary vote of thanks was moved by Fred Carruthers, VK2PF.

### HUNTER BRANCH

Twenty-five members and visitors were present at the April meeting of the Hunter Branch held at the Technical College, Tighes Hill.

There were two short lectures given by Keith Howard VK2AKX and Tony Mullen VK2ZCT, who discussed the forthcoming Federal Convention, and details of a transistor-regulated power supply.

Following this section of the meeting, two films, kindly lent by the Hunter District Water Board, were shown.

Two interesting lectures have been arranged for the July meeting which is to be held in Room 6, Clegg Building, Newcastle Technical College, Tighes Hill, on Friday 1st July. Visitors are always welcome at Hunter Branch Meetings.

Ian O'Toole, VK2ZIO, is the newest holder of a callsign in the Branch. A keen constructor, Ian has built all his own equipment and is regularly on the air on 6 and 2 metres with a fine signal.

He joins Frank Boundy VK2ZFX who gained his licence a few weeks previously and who also radiates a powerful signal on the VHF bands.

Yet another Branch member to successully complete the requirements for the full icence is Colin Christiansen, VK2BBC. olin, who now works as a clerk with the ost Office at Waverton, is on the air on 0 and 40 metres using surplus equipment vhich he has modified for amateur use. olin, who is 18, joins the ranks of young nembers of the Westlakes Radio Club who ave gained callsigns in the past four years.

### JUNE FIELD DAY

The Westlakes — Hunter Branch Field ay is to be held at the Westlakes Radio lub, Teralba on Sunday June 12th, 1966.

There will be a full program of events, he first to commence at the Club at 0 a.m. Competitors are advised that no ontestant will be allowed to enter an event nless an entry form is completed.

A canteen serving hot food, tea, coffee, nd soft drinks will be available at the lub.

You are assured of a good time at the Vestlakes — Hunter Branch Field Day on une 12th.

### CENTRAL COAST BRANCH

A most interesting and instructive lecture as given to members attending the April eeting of the Central Coast Branch of e W.I.A.

The lecturer was Alec Swinton VK2AAK d the subject was "UHF, and 432MC particular."

Using sketches and several pieces of uipment, Alec was able to demonstrate nstruction and testing techniques.

The equipment — included a veractor ode frequency tripler, field strength meter, nd edge marker, wave meter, a "Parks" 2MC converter and a 13 element yagi tenna, all being currently in use at his ation.

Tape recording of signals received from ick Norman, VK2ZCF, gave a clear dication of the possibilities the band offers VHF operators.

When discussing construction techniques was pointed out that there was a certain lationship to plumbing in 432MC equipent, but nevertheless it was simple to ild. It was also shown that large surface eas added to the efficiency, due to skin ect, and must be taken into account on e 432MC band.

The lecture concluded with a brief coverage on propagation in relation to the UHF bands.

Visitors are always welcome to the Branch meetings, held on the third Friday of the month, at the School of Arts, Gosford.

### BLUE MOUNTAINS BRANCH

The office bearers of the Blue Mountains Branch of the W.I.A. elected at the Annual Meeting were:—

Chairman, Derick Boyd, VK2NR; vice-chairman, Ron Daniels, VK2ADA; secretary, Bill Moore, VK2HZ; treasurer and catering officer, Allan Smith, Assoc.; Publicity Officer, Ron Daniels, VK2ADA; construction committee, Bob Lear, VK2ASZ, Trevor Huntley, VK2TM, Don Hodgins, VK2ART, Danny Cliff, Assoc.

At the March and April meetings of the branch the entertainment was provided by Ron Daniels VK2ADA, who showed slides and movie films of his trip to the U.S.A.

It is reported that a wide variety of subjects were covered, from Ham gatherings and "birds" to the "Indianapolis 500."

### NEPEAN DISTRICT CLUB

The newly formed Nepean Amateur Radio Club, organised by amateurs living in the St. Marys-Penrith area west of Sydney, will hold their first field day on Sunday, June 12. All amateurs and their friends are invited.

The centre of the activities will be located at the Penrith Civil Defence Headquarters in the St. Marys industrial area.

A registration fee of $1.50 will apply to amateurs and adult males, all other visitors will be free.

The program will commence with an all band scramble for those en route, starting at 9.30 a.m. Contestants must start at least 15 miles air line from St. Marys railway station and logs must be handed in at the registration desk by 10.45 a.m.

Prizes will be given for the highest score on the HF and VHF bands. Points for contacts will be:—

1 point for each contact plus bonus points, i.e.,

4 points for each overseas HF contact;

4 points for each interstate VHF contact;

9 points for each VHF overseas contact. VK6 and VK7 call areas will be classed as overseas contacts.

During the day there will be:—

Two 7MC mobile hidden transmitter hunts.

Two 144MC mobile hidden transmitter hunts;

Two 144MC pedestrian hidden transmitter hunts.

Novelty events for everyone.

A program giving all details will be available on registration.

Good prizes will be presented to the winners of all events.

Morning and afternoon teas will be provided. Hot water, soft drinks and icecream will be free but take your own lunch.

### VHF and TV GROUP

The annual meeting of the N.S.W. Division VHF and TV Group was held on April 1 at the Wireless Institute Centre. There were over fifty members present. There were 11 nominations for the committee of six resulting in a very interesting ballot.

Following a meeting of the elected committee the office bearers are:—

Chairman Stephen Kuhl, VK2ZSK, vice-chairman, Sandy Bruce-Smith, VK2ZEX. Secretary, Alf Wass, VK2ZIW. Contest committee, Chris Jones, VK2ZDD, Peter Carter, VK2ZPC, WICEN Liaison Officer, Ian McKenzie, VK2ZIM.

The committee has already made plans for a very interesting series of lectures for the monthly meetings held on the first Friday of each month.

It now seems certain that the activity planned for the holiday weekend June 12, will not be a full scale field day but probably a form of local message-handling contest. However, the latest details will be given over the VK2WI, VHF news broadcasts on a Sunday evening at 7.30 p.m.

An illustrated brochure giving details of equipment and component parts available from the disposals store are available and can be obtained by sending a stamped self-addressed envelope to the Secretary of the Disposals Committee, W.I.C., 14 Atchison Street, Crow's Nest.

### QUEENSLAND

The main activity within the Queensland Division of the W.I.A. was the 30th Federal Convention held over the Easter holiday period. (If I can be permitted to make a comment — the hospitality and facilities made available for delegates has never been surpassed at least during the past 10 years and the appreciation of all who attended is extended to the officers and members who were responsible for the arrangements. VK2APQ.)

The 1966 State Convention held over the weekend March 25-27 was very successful. More than thirty members and their families enjoyed near perfect weather at Alexandra Headland and participated in the many activities arranged.

Many interesting pieces of amateur equipment were on display, including a collection of popular SSB transceivers, mobile antennas, SWR indicators, antenna rotators and indicators.

The proceedings were also enlivened by the efforts of Max Swaby, VK4DA, in auctioning, as he put it, "the cream of amateur's surplus equipment."

The winners of the main events were: VHF mobile night event, A. J. Chappel VK4ZCA: Mobile Rally, R. C Wright, VK4ZRW; All Band Scramble (Saturday), M. J. Swaby VK4DA; All Band AM Scramble (Sunday), K. P. O'Farrell VK4OF; All Band SSB Scramble L. L. Sharp VK4NS; VHF Mobile Transmitter Hunt, L. A. Davies VK4ZLO.

Matters relating to WICEN Intruder Watch on bands and the GHOST Project were discussed at the general meeting.

### SOUTH AUSTRALIA

The WICEN Co-ordinator of the South Australian Division, Geoff Taylor VK5TY, received two letters of appreciation for services given by WICEN operators. The first from F. L. Kerr, Director, Emergency Fire Service, Thebarton.

"Please accept and convey to your

*AEGIS
AERIAL SYSTEM

We've had years of experience manufacturing NOISE REDUCING Aerial Systems for use in noisy locations . . . Our Kits are the finest you can buy! Available everywhere, write for our* illustrated leaflet.

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347 Darebin Rd., Thornbury,
Victoria. 'Phone 49-1017.

A22.

# HAM RADIO SUPPLIERS

5A MELVILLE STREET, HAWTHORN, VICTORIA
Phone 86-6465 **ESTABLISHED 1947**

## SINCLAIR X-20

### INTEGRATED 20 WATT PULSE WIDTH MODULATED AMPLIFIER AND PRE-AMP

### A new concept in high fidelity performance

The use of P.W.M. assures a far better transient response than is possible with other amplifiers and this adds greatly to the quality of reproduction from the speaker.

Harmonic distortion is so low as to be hardly measurable, let alone audible, and cross-over distortion, which can cause such marked unpleasant effects in conventional transistor amplifiers, simply cannot occur at all in the X-20.

| | |
|---|---|
| Number of transistors: | 12 |
| Overall size: | 8¼in x 3¼in x1in. |
| Weight: | 4½oz. |
| Input sensitivity: | 1mV into 5kΩ. |
| Total harmonic distortion: | Less than 0.1% at 10 W. |

**Output power into 7.5 or 8 ohm speaker:**
20 watts R.M.S. music power.
15 watts R.M.S. continuous.

**Output power into 15 ohm speaker:**
15 watts R.M.S. music power.
12 watts R.M.S. continuous.

These output ratings are quoted to the standard British method of rating. Using the method usually employed in the U.S.A., these ratings would be doubled, giving, for example, 40 watts music power into a 7.5 ohm speaker.

Frequency response, at all power levels: 20 c/s to 20 kc/s plus 1 db.

| | |
|---|---|
| Damping factor: | Greater than 100. |
| Quiescent consumption: | About 150 mA. |
| Supply voltage: | 28 to 37 volts (7.5Ω speaker).<br>28 to 45 volts (15Ω speaker). |
| Signal to noise ratio: | Better than 70 dB. |
| Pulse repetition frequency: | 65 to 75 kc/s. |

Energy conversion factor at output at least 95% efficient.

A filter is built into the output of the X-20 so that it may be used with any type of resistive or inductive load of the correct impedance.

## X-20 AMPLIFIER

**Completely Built and Tested.**

**Price £16/15/- $33.50**

## X-20 A.C. MAINS POWER

Supply (200-240 volts).
Suitable for driving up to
2 x 20 Units.

**Price £7/17/6. $15.75 inc. tax**

## 12-VOLT TRANSISTORISED POWER SUPPLY

Q Plus type TPS50/12.
INPUT: 12 volts DC.
OUTPUT: 300 and 150 volt DC 50 watts continuous operation.
FREQ.: 1200 c/s approx.
As-new condition.

**Price £11/10/-. $23.00**

**Post extra.**

## FERROCART POCKET MULTIMETER

### Model PT34

300 uA movement.
AC and DC voltages: 0-10, 0-50, 0-250, 0-500, 0-1,000c.
Current ranges (mA) 0-1, 0-100, 0-500 mA.
Ohms range: 0-100,000
Size 3¾ x 2½ x 1¼ inches.

**Price 57/6. $5.75**

Complete with leads.

## ALIGNMENT TOOLS

Jabel No. 4 Alignment Tool Kits. All popular sizes. 4 Tools in Plastic Pouch .. **$1.20 (12/)**

## TRANSISTORS AND DIODES

| | | |
|---|---|---|
| AC125 | 9/6 | 95c |
| AC126 | 9/6 | 95c |
| AC127 | 10/6 | $1.05 |
| AC128 | 10/ | $1.00 |
| AF114N/OC171 | 10/ | $1.00 |
| AF115N/OC170 | 10/ | $1.00 |
| AF116N | 9/6 | 95c |
| AF117N | 9/6 | 95c |
| AF118 | 22/ | $2.20 |
| BC107 | 11/ | $1.10 |
| BC108 | 10/ | $1.00 |
| BC109 | 14/ | $1.40 |
| OC26 | 26/ | $2.60 |
| OC35/AT1138A | 35/ | $3.50 |
| OC44N | 11/ | $1.10 |
| OC45N | 11/ | $1.10 |
| OC70 | 12/ | $1.20 |
| OC71/2N215 | 7/6 (or 3 for £1) | 75c (or 3 for $2) |
| OC72 | 13/6 | $1.35 |
| OC74N | 9/6 | 95c |
| OC75 | 13/6 | $1.35 |
| OC169 | 19/6 | $1.95 |
| OC170/AF115N | 10/ | $1.00 |
| OC171/AF114N | 10/ | $1.00 |
| 2N217 | 9/6 | 95c |
| 2N270 | 13/6 | $1.35 |
| 2N370 | 19/ | $1.90 |
| 2N372 | 19/ | $1.90 |
| BY100/OA214 | 16/ | $1.60 |
| OA79 | 4/ | 40c |
| OA80 | 3/ | 30c |
| OA81 | 3/ | 30c |
| OA90 | 3/3 | 32c |
| OA91 | 3/3 | 32c |
| OA95 | 3/3 | 32c |
| OA200 | 7/6 | 75c |
| OA210, 1N1763, 1N3194, HR25 | 8/6 | 85c |
| OA211, S10AR2 | 16/ | $1.60 |
| 1N3491 40 piv 18 amp | 9/6 | 95c |

## ZENER DIODES

| | | |
|---|---|---|
| OAZ200 | 15/6 | $1.55 |
| OAZ212 | 12/6 | $1.25 |
| OAZ213 | 12/6 | $1.25 |
| OAZ222/BZZ14 | 27/6 | $2.75 |
| OAZ224/BZZ16 | 27/6 | $2.75 |

## ELECTROLYTIC CAPACITORS

| F.D. | —VOLTS | PRICE | F.D. | —VOLTS | PRICE |
|---|---|---|---|---|---|
| 2 M.F.D. | 12 | 35c | 50 | 150 | 75c |
| 4 | 3 | 30c | 50 | 350 | 1.35 |
| 5 | 6 | 30c | 50+50 | 350 can | 1.60 |
| 5 | 12 | 30c | 50 | 450 | 1.35 |
| 5 | 18 | 35c | 64 | 6 | 35c |
| 8 | 10 | 30c | 64 | 18 | 35c |
| 8 | 15 | 30c | 100 | 3 | 35c |
| 8 | 350 | 48c | 100 | 6 | 35c |
| 8 | 525 | 58c | 100 | 12 | 35c |
| 10 | 3 | 30c | 100 | 25 | 50c |
| 10 | 6 | 30c | 100 | 50 | 72c |
| 10 | 15 | 35c | 100 | 100 | 75c |
| 10 | 25 | 35c | 100 | 200 can | 1.05 |
| 16 | 10 | 35c | 100 | 300 | 1.83 |
| 16 | 300 | 50c | 100 | 350 can | 1.60 |
| 16 | 525 | 75c | 125 | 3 | 35c |
| 20 | 200 | 62c | 150 | 150 | 75c |
| 24 | 350 | 65c | 200 | 25 | 65c |
| 24 | 500 | 97c | 200 | 50 | 90c |
| 25 | 3 | 32c | 250 | 3 | 50c |
| 25 | 6 | 35c | 250 | 6 | 55c |
| 25 | 12 | 35c | 250 | 16 | 55c |
| 25 | 18 | 35c | 250 | 25 | 75c |
| 25 | 25 | 35c | 250 | 50 | 95c |
| 25 | 50 | 45c | 500 | 12D | 50c |
| 25 | 300 | 62c | 500 | 25 | 88 |
| 25 | 600 | 98c | 500 | 50 | 1.25 |
| 30 | 6 | 35c | | | |
| 30 | 12 | 35c | 1000 | 6 | 92c |
| 32 | 350 | 70c | 1000 | 12 | 1.05 |
| 50 | 6 | 32c | 1000 | 18 | 1.25 |
| 50 | 12 | 35c | 1000 | 25 | 1.48 |
| 50 | 25 | 47c | 2000 | 18 | 1.70 |

## CRYSTALS

Crystals in FT243 Holders. As New EX SCR536/BC611 Walkie-Talkies.

| | |
|---|---|
| 4080 Kc. | 5327 Kc. |
| 4397 Kc. | 5360 Kc. |
| 4495 Kc. | 5385 Kc. |
| 4676 Kc. | 5397 Kc. |
| 4695 Kc. | 5660 Kc. |
| 4735 Kc. | 5780 Kc. |
| 4815 Kc. | 5852.5 Kc. |
| 4840 Kc. | 5920 Kc. |
| 4852 Kc. | 6235 Kc. |
| 4950 Kc. | 6375 Kc. |
| 5205 Kc. | 7/6 each or 3 for £1 |
| 5295 Kc. | 75c each or 3 for $2.00 |

## CRYSTALS in DC 11 HOLDERS

| | | | | | |
|---|---|---|---|---|---|
| 5980 Kc. | 12/6 | $1.25 | 5980 Kc. | 12/6 | $1.25 |
| 6420 Kc. | 12/6 | $1.25 | | | |

## CITIZENS BAND CRYSTALS

Miniature HC6/U ½" pin spacing
27.240 Megacycle 27/6 each.
26.785 Megacycle 27/6 each.
HC6/U Crystal Sockets 2/9
FT243 Crystal Sockets 2/9

**CLIENTS NOTE, THE ABOVE FREQUENCIES ONLY AVAILABLE AT THE MOMENT.**

## NEW VALVES

| | |
|---|---|
| 1A3 | 50c |
| 1A5 | 50c |
| 1A7GT | $2.60 |
| 1C7 | 50c |
| 1D8 | 75c |
| 1F5 | $1.00 |
| 1H5 | 75c |
| 1K5 | 50c |
| 1K7 | 50c |
| 1L4 | 50c |
| 1L5 | $1.00 |
| 1Ln5 | 50c |
| 1M5 | 50c |
| 1P5 | 50c |
| 1Q5 | 50c |
| 1R5 | $1.90 |
| 1S2 | $1.75 |
| 1S5 | $1.60 |
| 1T4 | $1.00 |
| 1U4 | $1.60 |
| 1U5 | $1.60 |
| 2A5 | 75c |
| 2C42 | $1.50 |
| 2C46 | $.150 |
| 2D21 | $1.20 |
| 2X2 | 50c |
| 2A7 | 75c |
| 2E26 | $2.50 |
| 3A5 | $1.00 |
| 3A4 | $2.20 |
| 3S4 | $1.00 |
| 3V4 | $1.50 |
| 3Q5 | $1.00 |
| 5U4GB | $1.45 |
| 5V4G | $1.75 |
| 5Y3 | $1.38 |
| 5AR4 | $2.60 |
| 5AS4 | $1.45 |
| 5R4Gy | 03.75 |
| 5Z3 | $1.75 |
| 5T4 | $1.75 |
| 5Y4 | 75c |
| 5819 Vidicon | $10 |
| 5636 | 75c |
| 6A6 | 75c |
| 6AB7 | $1.00 |
| 6AC7 | 75c |
| 6AG5 | 50c |
| 6AG7 | $1.25 |
| 6AJ5 | 75c |
| 6AK5 | $1.50 |
| 6A3 | 75c |
| 6AL5 | $1.40 |
| 6AM5 | $1.50 |
| 6AM6 | $1.00 |
| 6AS7Gt | $2.00 |
| 6B6 | 75c |
| 6BE6 | $1.50 |
| 6BQ5 | $1.70 |
| 6CW4 | $3.00 |
| 6C8 | $1.00 |
| 6C6 | 50c |
| 6CM5 | $2.25 |
| 6F8 | 50c |
| 6G6 | 75c |
| 6G8G | $2.60 |
| 6H6Metal | 50c |
| 6J6 | $1.00 |
| 6J5GT | $1.00 |
| 6K7 | 50c |
| 6K8GT | $1.25 |
| 6K8Metal | $2.00 |
| 6L7 | 50c |
| 6N7 | 50c |
| 6R7 | 75c |
| 6SC7 | 75c |
| 6SF5 | 75c |
| 6SF7 | 75c |
| 6SH7 | 50c |
| 6SJ7 | $1.25 |
| 6SK7GT | $2.00 |
| 6SL7gT | $1.25 |
| 6SL7GT | $1.25 |
| 6SN7GT | $1.00 |
| 6SQ7GT | $2.60 |
| 6SS7 | 75c |
| 6U7 | 75c |
| 6U8 | $1.70 |
| 6V4 | $1.14 |
| 6S5 | 75c |
| 6K6 | $1.00 |

| | |
|---|---|
| 6V6GT | 16/- |
| 6X4 | 10/- |
| 6X5 | 13/- |
| 6AN7A | 16/- |
| 6AR7GT | 20/- |
| 6AU6 | 13/- |
| 6U5 | 18/- |
| 6CH6 | 25/- |
| 6CG7 | 15/- |
| 6BZ6 | 15/- |
| 6BY7 | 15/- |
| 6BX6 | 15/- |
| 6BR5 | 15/- |
| 6BQ5 | 14/- |
| 6BM8 | 15/- |
| 6BL8 | 18/- |
| 6BE6 | 15/- |
| 6BA6 | 16/- |
| 6AV6 | 13/- |
| 6AU8A | 23/- |
| 7A8 | 4/- |
| 7C5 | 5/- |
| 7C7 | 5/- |
| 7E6 | 5/- |
| 7W7 | 5/- |
| 717A | 7/ |
| 7L7 | 7/ |
| 12A6 | 5/- |
| 12AH7 | 5/- |
| 12AT7 | 7/ |
| 12AU7 | 15/- |
| 12AV6 | 7/ |
| 12BE6 | 7/ |
| 12C8 | 5/- |
| 12J5 | 5/- |
| 12SA7GT | 10/- |
| 12SC7 | 5/- |
| 12SK7 | 5/- |
| 12SQ7 | 5/- |
| 12SR7 | 5/- |
| 12SN7 | 7/ |
| 19 | 5/- |
| 30 | 5/- |
| 47 | 5/- |
| 57 | 5/- |
| 58 | 5/- |
| 80 | 17/- |
| 16A5 | 17/- |
| 16A8 | 21/- |
| 832A | 60/- |
| 830B | 15/- |
| 808 | 10/- |
| 866 | 25/- |
| 1626 | 5/- |
| 1629 | 5/ |
| 25L6 | 10/- |
| 25Z6 | 10/- |
| 954 | 5/- |
| 955 | 5/- |
| 956 | 5/- |
| 958A | 5/- |
| 5763 | 28/- |
| 6021 | 10/- |
| 9004 | 5/- |
| EA50 | 4/- |
| ECC35 | 20/- |
| ECH33 | 20/- |
| EF50 | 5/- |
| EF86 | 26/- |
| UL41 | 10/- |
| EY91 | 5/- |
| OOF03/12 | 47/ |
| QQ104/7 | 25/- |
| RL18 | 7/ |
| UL41 | 7/ |
| VR102 | 5/- |
| VR135 | 5/- |
| VR136 | 5/- |
| VR137 | 5/- |
| VT78 (6D6) | 5/- |
| VT127 | 5/- |
| VT501 | 7/ |
| 1D4 | 7/ |
| 1M4 | 5/- |
| 7L7 | 7/ |
| 7N7 | 7/ |
| 12SG7 | 7/ |
| 3516GT | 10/- |
| VU39A | 5/- |
| ECH35 (VR99A) | 7/ |

## VERNIER DIALS

Ratio 8 to 1, reduction, scaled 0-10.
Type T501, 1½in diam. .. .. .. **$1.75 (17/6**
Type T502, 2in diam. .. .. .. **$2.20 (22/**
Type T503, 3in diam. .. .. .. **$2.80 (28/**

## GRID DIP OSCILLATORS

Lafayette TE-18 G.D.O. 8 Bands, Plug
Coils, 360 Kc-220 M/C, 240 volt, £19/15/-

members, my appreciation of the valuable service they rendered in supplementing the E.F.S. Communications at the Crafers/ Waterfall Gully fire of 8th February.

"The Commissioner of Police, Brig. J. G. McKinna, has requested that I also convey his thanks to WICEN and other volunteers who played a part in this fire."

The second was from N. W. Pratt, Hon. Secretary, Stirling Fire Unit.

"My committee has instructed me to write to you to ask if you would convey to the members of your group who assisted at the recent Crafers fire, our very sincere thanks for their services rendered to our E.F.S. units and for their splendid co-operation.

"My committee has appreciated the co-operation received from your organisation over the past number of years and we look forward to your continued support."

### VHF GROUP

The officers elected at the Annual meeting of the VHF Group were:-

President: Eric Jamieson, VK5ZEJ

Vice-President: Rick Matthews, VK5ZFQ.

Secretary-Treasurer: Jim Sinclair, VK5ZSJ

Councillors; Brian Tideman, VK5TN. Curl Blythe, VK5CL.

It is also reported that two members of the Group experimented as much as it was possible with the Oscar IV satellite. They were Mick McMahon, VK5ZDR and John Hackworth VK5ZJH. John has quite a length of tape recording his own signals coming back from the satellite. To encourage more 432MC activity John is scheduled to lecture on his equipment.

### WEST AUSTRALIA

The monthly meeting of the West Austra-ian Division of the W.I.A. is held on the hird Tuesday of each month at the Perth Technical College. Proceedings commence at 8 p.m.

At a recent meeting Brigadier Hunt ddressed members on matters relating to Civil Defence. He stated that he was urprised to hear the statement made that he C.D.E.S. was not interested in having he aid of amateur radio in an emergency.

He had spoken to both the Police and Civil Defence authorities, and they fully ppreciated the value of the amateur service. However, the Civil Defence Emergency ervice in the State was not at the stage f development where it could use radio ervices.

Brian Pemberton, VK6VW, WICEN Co-ordinator reports that good progress is eing made with nets organisation and pays ribute to the valuable assistance given by Brigadier Hunt.

Inquiries are being made among members or those who are interested in taking part the 1966 Scout Jamboree-on-the-Air, over e weekend October 22nd-23rd.

The Boy Scouts Association will be olding a camp at a new site 8½miles east f Byford, 28 miles east of Perth, over e weekend and are anxious to participate the event. The Association is prepared arrange transport, hire an alternator if ecessary and erect aerials.

It has been suggested that 80, 20 and 6 etre bands be used and S.S.B. would be eferable on 20 metres.

Anyone wishing to take part or loan uipment are invited to contact the Secre-ry, Neil Penfold, VK6ZDK, Box no. 1002, .P.O., Perth.

A regular fortnightly news service for the nefit of listeners in Cocos and Christmas ands and remote areas of West Australia, as started on April 3.

This broadcast of news will be transmit-l from VK6WI every alternate Sunday 0550 G.M.T. on approximately 14.1MC single side band. Reports on the trans-ssions are invited.

### VHF BAND NEWS

From George Francis, VK3ZCG, of Mor-ll, Victoria, details have been received of other 144MC DX contacts that were made from Gippsland following the VK-ZL openings that took place at the beginning of the year.

George's log has these entries:

February 22.

| EST | Worked | Location |
|---|---|---|
| 0032 | VK3ZTN | Hamilton 275 miles |
| 0709 | VK3ZDM | Ballarat 146 miles |
| 0754 | VK3NN | Yanac 298 miles |
| 2105 | VK3ZEF | Bendigo 149 miles |

February 27.

| EST | Worked | Location |
|---|---|---|
| 0736 | VK3NN | Yanac 298 miles |
| 0837 | VK5CJ | Mt. Gambier 300 miles |
| 0900 | VK3ZCN | Bendigo 149 miles |
| 1006 | VK5ZFA | Millicent **338** miles |
| 1100 | VK5ZDR | Adelaide 480 miles |
| 1119 | VK5GP | Mt. Lofty 460 miles |
| 1220 | VK3ZER | Geelong **115** miles |

March 1.

| EST | Worked | Location |
|---|---|---|
| 2217 | VK5GP | Mt. Lofty 480 miles |

March 27.

| EST | Worked | Location |
|---|---|---|
| 2132 | VK3ZEF | Bendigo 149 miles |

George also reports that on February 10 VK3ZPL, located in Moe, worked several VK4 stations in Brisbane on the 52MC band, heard VK2AXB Sydney around 2046 EST and obtained excellent reception of TV Channel 0, Brisbane. Channel 3, ABNT3, Northern Tasmania was received by VK3AWV located at Yallourn.

On April 3, George worked VK4XC in Bundaberg, Queensland. Also heard signals on the six-metre AM net frequency. More than 10 stations are active in Gippsland on the 144.854MC FM net and visitors passing through Gippsland are invited to join in the net activities.

From the Hunter Valley and Newcastle area Mac O'Brien, VK2ZMO, reports that a local net is active around 10 a.m. each Saturday, Sunday and holidays around 52.5MC. Stations to be heard are VK2's ZKW, ZWM, ZMO, ZUB, ZCT. Also, at times, VK2's AYF, ZJG, ZBD and ZDN join the net. It is rumoured that, because of the time it has been going on, there is to be a prize given to the one who can state accurately the year that Gordon Sutherland, VK2ZSG, Hunter Branch Secretary, will join the net.

In the same area 144MC activity is very good and the stations that can be heard almost nightly are: VK's 2ZKW, 2ZSG, 2ZWM, 2YJ, 2ZCT, 2XT, 2ZFR, 2ZDN, 2ZCU, 2ZMO. Others active are VK's 2AYL, 2AYF, 2ZBD, 2ZJG, 2ZAP. VK3ZTL has been operating portable from Nelsons Bay while VK7ZBW was worked while in Newcastle on his way through from Brisbane.

Sydney stations VK2ZTM mobile, VK2AXB, VK2ZBQ and VK2HE were all worked at readability 5 strength 9 during an opening on March 7.

### TRANS TASMAN

Confirmation has been received that three contacts were made with ZL1TCN on January 3rd. VK2ZVL and VK2ZRH, both operating portable from Mount Bald in the Snowy Mountains, and VK2ZVW, portable at Mount Kosciusko, were the stations concerned.

In a letter received from Albert Birch VK2ZFB of St. Mary's, N.S.W., interesting details not previously published, of the N.Z.A.R.T. "Worked all Districts VHF Award" were given.

"Queries addressed to Jock White, ZL2GX, Contest and Awards Manager, N.Z.A.R.T., regarding the W.A.D. (VHF) Award resulted in a complete list of VK

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## W.I.A. YOUTH RADIO SCHEME

A comprehensive report on the activities of the W.I.A. Youth Radio Scheme prepared by Rex Black, VK2YA, Federal co-ordinator of the scheme, was presented to delegates attending the Federal Convention held in Brisbane at Easter.

The report indicated that the year had been one of consolidation and no spectacular developments had been aimed for.

By the results achieved by former and present members of the scheme, in obtaining amateur operator's licences, the institute had materially benefitted by a certain proportion of increased membership.

In referring to the benefit to the community the report read:

"One of the most pleasing features of this year's progress lies in the field of relationships with the electronics industry.

"Increasing numbers of employers are realising the desirability of employing school leavers who have an established interest in radio at a hobby level. The Youth Radio Scheme offers a pool of potential apprentices, trainees and cadets. Also, as the number of radio hobbyists in the community increases, so the market for radio parts and equipment increases.

"For both these reasons Y.R.S. is receiving support from the industry in the form of donation of parts, prize money and publications."

Special mention was made of the following donations:

1. Soldering irons from Mr Royston of Adcola Products Pty. Ltd., Melbourne.
2. Kitsets from Mr K. Lane of Transistor Kits, Melbourne.
3. Screwdriver sets from Turner Manufacturing Co., Melbourne.
4. Books to the value of £3 from Technical Book and Magazine Co., Melbourne.
5. Transistors from Anodeon Sales Division Melbourne.
6. Radio parts from Mr Angus Fowler of Kriesler (Australasia) Pty. Ltd., Sydney.
7. £10 prize money from the Overseas Telecommunication (Australia) Commission.
8. Multiflash Project cards and transistors from Mr Ron Schonrock of, Amalgamated Wireless Valve Company Pty. Ltd., Sydney.
9. Philips Electronic Kit from Mr Skipper, sales manager, Philips Electrical Pty. Ltd., Sydney.
10. 100KC Crystal from Pye Pty. Ltd., Melbourne.

In addition, many W.I.A. members have donated quantities of useful equipment, some of which has been distributed by the New South Wales Division to Y.R.S. supervisors in other States.

The report made reference to the various grades of certificates issued to students during the past year and the work and assistance given by those associated in some way in the operation of the scheme.

Reference was also made to the novice type licence, issued by the authorities in other countries, and the hope expressed that the time is not too far off when a similar grade of licencing is issued by the Australian authorities.

A.R.R.L.

Asoc. Memberships (and renewals) are available by forewarding $5.40 ($5.45 interstate cheques)

to:—

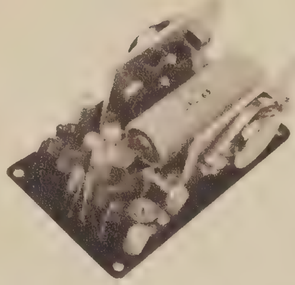
Business Manager, W.I.A.
49 Cookson Street,
Camberwell, E6., Victoria.

This includes regular delivery of

"QST"

to your home address.

SINCLAIR



Z12
Amplifier

SPECIFICATIONS:

Number of transistors: 8.
Overall size: 3" x 1.8" x 1.3".
Weight: 3ozs.
Output power into 3 Ω load:
5 watts RMS continuous with 12v supply.
8 watts RMS continuous with 15v supply.
13 watts RMS continuous with 18v supply.
Output power into 1.5 Ω load:
10 watts RMS continuous with 12v supply.
16 watts RMS music power with 15v supply.
Power response: 1.5 dB below 1 K c/s at 20 K c/s and 65 c/s.
Frequency response: 15 c/s to 50K c/s ± 1 db.
Input sensitivity: 2mV into 2K Ω.
Quiescent consumption on 12v supply: 15mA.
Signal to noise ratio: better than 60 dB.
Total distortion: less than 1 per cent.

*Send now for full technical details and literature on the Z12 and X20 Amplifiers or order now*
*Wholesale enquiries welcomed*

CENTRAL IMPORTS
34 JAMES STREET, PERTH, WESTERN AUSTRALIA
Import Agent—Distributors, Telephone 28-1212 Sinclair Agents in West. Australia

WILLIAM WILLIS & CO. PTY. LTD

HAVING T.V.I. TROUBLE?

**A "Cabena" Low Pass Filter will fix it!** Cut-off frequency, 30 Mc., attenuation at 60 Mc., better than 30 db.; insertion loss, negligible; impedance, 50-72 ohms.
**Price: $11.50 (inc. S.T.)**

TRANSMISSION LINE EQUIPMENT

Formula III. Low-Loss 300 ohm open wire Transmission Line. 100ft lengths, coiled and boxed. Price **$5.18** (inc. S.T.).
14 gauge hard-drawn Copper Wire for Amateur Antenna Systems. Any length cut. Price: **6c** per yard (inc. S.T.).
Porcelain Egg-type insulators. Price: **$1** doz. (inc. S.T.).

PENETROX "A"

Famous American aluminium and copper corrosion inhibiter. Avoid bad electrical connections and corroded joints on beam antennae, TV antennae, etc. Use —
PENETROX "A"
Price: **$1** per tube
(Post Paid)

American "Dage" Standard V.H.F. CO-AX CONNECTORS

(As used widely in "QST" and "CQ" circuits and on disposals equipment)
PL259 Co-ax Plugs (PTFE) .. .. .. **98c**
SO239 Co-ax Sockets (PTFE) .. . .. **90c**
UG-176-U Adaptors, adapts PL259 Plugs to range of Co-ax Cable diameters .. **32c**
C32-14 Co-ax Couplings, couple two PL259 Plugs (PTFE) .. .. **$1.75**
C32-17 "T" Co-ax Joiner (PTFE) .. .. **$2.32**
(Useful for sampling r.f. in transmission line for c.r.o. measurement.)
C32-16 Right Angle Co-ax Connector (PTFE), male to female . . .. .. **$1.88**
(Prices include Sales Tax).

"JABEL" TR14 REAMERS

Ideal for clean finish on small panel holes and cleaning out for neat fit.
Price: **$1.05** each.

F455 – FA – 21 FILTERS

**COLLINS Type F455A Mechanical Filters,** 455 Kc. Wiring instructions with each unit.
Price (inc. S.T.): **$35.**

KIKUSUI
MODEL 539 3" C.R.O

240 a.c. operation, Printed Circuit Board wiring, 5 c.p.s to 1 Mc., time base oscillato sweep 10 c.p.s. to 100K c.p.s. in steps with continuous in-between variation. Ideal s.s.b measurement with coupled r.f. sampling signal. Weight, 11 lb.
Price: **$110** plus 12½ p.c. S.T.
(Full instruction book supplied)

GELOSO KIT FOR D.S.B. TRANSMITTER

The following components comprise the GELOSO Kit for construction of D.S.B. Transmitter. For circuit details refer Nov. '65 issue of "Electronics Australia."
4/105 Crystal controlled Beat Frequency Oscillator .. .. .. . . .. .. **$25**
N.1657 Calibrated Dial, Pointer and Escutcheon .. .. .. .. .. .. .. .. .. **$5.60**
N.4/113 Pi-Coupler .. .. .. .. .. .. **$4.30**
N.771 Condenser .. .. .. .. .. .. .. .. **$3.95**
N.774 Condenser .. .. .. .. .. .. .. **$3.95**
N.17634 All Wave R.F. Choke .. .. .. **85c**
All plus 12½ p.c. Sales Tax.
Valves not supplied with VFO.
Valves for VFO: 6U8, 6AH6, 6CL6.

428 ELIZABETH STREET, MELBOURNE, C.1
Phone 34-6539

(Australian) recipients. The N.Z.A.R.T. p neered numbering awards consecutively a on a country basis.

"Out of 68 awards, 20 have gone to V call areas, the rest to W and VR2 C areas. The awards to Australian stations a

| Certificate No. | Station | VK No. |
|---|---|---|
| 18 | VK2VW | 1 |
| 38 | VK5RO | 2 |
| 44 | VK6DW | 3 |
| 45 | VK2HE | 4 |
| 46 | VK3KC | 5 |
| 47 | VK3YS | 6 |
| 55 | VK2ABR | 7 |
| 56 | VK2MZ | 8 |
| 57 | VK5ZAX | 9 |
| 58 | VK5ZBZ | 10 |
| 59 | VK4ZAA | 11 |
| 60 | VK4TY | 12 |
| 61 | VK5ZGA | 13 |
| 62 | VK4WD | 14 |
| 63 | VK2ZVL | 15 |
| 64 | VK9XK | 16 |
| 65 | VK3ZIG | 17 |
| 66 | VK2ZFB | 18 |
| 67 | VK7ZAP | 19 |
| 68 | VK2ZVW | 20 |

Certificate number 68, the 20th issued an Australian station, was awarc to David MacNaughton, VK2ZVW, working all ZL districts on the 144M band. The award for 144MC is the fi awarded to a VK call area.

Albert Birch, VK2ZFB, has received co firmation from Edwin Schoell, VK5Z who, on December 17th, 1965 from 10 hours to 1022 hours S.A.S.T., copied 144.170MC transmission at readability strength varying from 7 to 9 over that sh period.

### ROSS HULL MEMORIAL CONTES

The results of the 1965-66 Ross H Memorial Contest, for operators on VHF bands, revealed that the number entries were the lowest in the contes history.

From the logs received and the l scoring it appears that the band openir were very few and not what was anticipat It was also obvious that TV Channel O Melbourne and Brisbane restricted ope tion of stations in those cities.

The report of the W.I.A. Federal Cont Committee reviewed several comments the existing rules of the contest, made contestants, and pointed out that such co ments will be used to improve the rules an endeavour to attract more participants

The awards made were:—

| **Trophy Winner** | | 9 Day period points | 48 Ho peric poin |
|---|---|---|---|
| VK3ZIM | R. J. Beames | 936 | 291 |
| **Award Winners** | | | |
| | **Section A Transmitting Open** | | |
| VK5ZF | I. L. O'Donnell | 41 | 18 |
| | **Section B Transmitting Phone** | | |
| VK1VP | E. Penikis | 193 | 193 |
| VK2ZFB | A. F. Birch | 252 | 9 |
| VK3ZDM | R. J. Beames | 936 | 291 |
| VK4ZLP | P. J. Lindsay | 99 | 5 |
| VK5ZKR | C. H. Hutchesson | 413 | — |
| VK6ZAL | I. G. Stimson | 55 | 3 |
| VK7ZAH | K. J. Hendricks | 478 | 24 |
| VK8ZMR | Richardson<br>M. D'Arcy | 10 | 1 |
| ZL3AD | G. E. Alderson | 337 | 22 |
| | **Two Day Highest Scoring Log** | | |
| VK7RL | R. V. Bulman | 443 | 33 |
| | **Section C Receiving** | | |
| L3229 | R. J. Halligan | 275 | — |

### ALGEBRAIC EQUATION

In the April issue of the West Austral Divisions Bulletin the following equat was given:

HAM — YL = + DX
HAM + YL = — DX
HAM + DX = — YL
Where HAM = Amateur Radio Opera
DX = Overseas Contacts
YL = Young Lady.

# VK-ZL-OCEANIA DX CONTEST

The Federal Contest Committee of the W.I.A. takes pleasure in presenting the results of the 1965 VK-ZL Oceana Contest. The winners of awards have been listed in the results using heavy type.

### AUSTRALIA

C.W.—

| Call | 80 | 40 | 20 | 15 | Total |
|---|---|---|---|---|---|
| VK1VK | — | — | 2610 | — | 2610 |
| 2EO | 220 | 3810 | 11150 | — | 15180 |
| 2APK | 55 | 2260 | 4545 | 2440 | 9300 |
| 2VN | — | — | 5235 | 1215 | 6450 |
| 2QL | 650 | 1260 | 1865 | 1535 | 5310 |
| 2GW | — | 4375 | — | — | 4375 |
| 2QK | — | 1845 | 2225 | — | 4070 |
| 2PV | — | — | 3400 | — | 3400 |
| 2IC | — | — | 3130 | — | 3130 |
| 2RA | — | 275 | 970 | 375 | 1620 |
| VK2ASI 55 pts. (10 mx.) | | | | | |
| VK3AXK | 165 | 2785 | 4845 | 585 | 8380 |
| 3MR | — | — | 8140 | — | 8140 |
| 3DQ | — | 1555 | 3275 | 1910 | 6740 |
| 3NC | — | — | 5525 | — | 5525 |
| 3YD | — | — | 4710 | — | 4710 |
| 3XB | 740 | 1265 | 1295 | 345 | 3645 |
| 3APN | — | 2920 | — | — | 2920 |
| 3RJ | — | — | — | 2745 | 2745 |
| 3ABA | — | — | — | 1815 | 1815 |
| 3ABR | — | — | 1215 | — | 1215 |
| 3ARV | — | — | 695 | — | 695 |
| 3QV | — | 665 | — | — | 665 |
| 3YU | — | — | 435 | — | 435 |
| 3KS | — | — | 110 | — | 110 |
| VK4LT | — | 690 | 5305 | 3755 | 9750 |
| 4VX | — | — | 6740 | 1290 | 8030 |
| 4SD | — | — | 5060 | — | 5060 |
| 4UC | — | — | 1735 | — | 1735 |
| 4WO | — | — | 1290 | — | 1290 |
| 4XJ | — | — | 1285 | — | 1285 |
| 4PJ | | | | | Check |
| VK5FH | — | — | 4645 | — | 4645 |
| 5MY | — | 1775 | 1780 | — | 3555 |
| 5KO | 1235 | — | — | — | 1235 |
| 5BS | — | 680 | 320 | — | 1000 |
| VK6SM | — | — | 4505 | 3450 | 7955 |
| VK7SM | — | 490 | 2910 | 1570 | 4970 |
| 7DK | — | 1325 | 1580 | — | 2905 |
| 7GV | — | — | 925 | — | 925 |
| 7RY | — | — | 380 | — | 380 |
| VK8DI (W7PGX op.) | — | 290 | 2040 | — | 2330 |
| 8DI | — | — | — | 1360 | 1360 |
| VK9GC | — | — | 3500 | 1200 | 4700 |
| 9CJ | — | — | 620 | — | 620 |

PHONE—

| Call | 80 | 40 | 20 | 15 | Total |
|---|---|---|---|---|---|
| VK1VK | — | — | 2330 | — | 2330 |
| VK2APK | — | 970 | 5640 | 1450 | 8060 |
| 2KM | — | — | 3035 | — | 3035 |
| 2AGE | — | — | 2335 | 330 | 2665 |
| 2ASI | — | — | — | 2405 | 2405 |
| 2WD | — | — | 2275 | — | 2275 |
| 2AUS | — | — | 2190 | — | 2190 |
| 2VN | — | — | 1075 | — | 1075 |
| 2ACD | — | — | 950 | — | 950 |
| 2APQ | — | — | 55 | — | 55 |
| 2ACZ | | | | | Check |
| 2MR | | | | | Check |
| 2CM | | | | | Check |
| K3ATN | 1125 | 3000 | 8585 | 2375 | 15250 |
| VK3ATN 165 pts. (10 mx.) | | | | | |
| 3AKS | — | — | 3590 | — | 3590 |
| 3LW | — | — | 1585 | — | 1585 |
| 3XB | — | 575 | 1150 | — | 1725 |
| 3SM | — | — | 1240 | — | 1240 |
| 3ABA | — | — | — | 800 | 800 |
| 3VZ | — | — | 740 | — | 800 |
| 3KS | — | — | 650 | — | 650 |
| 3QV | — | 520 | — | — | 520 |
| 3TL | | | | | Check |
| K4LT | — | 55 | 5680 | 1595 | 8190 |
| VK4LT 860 pts. (10 mx.) | | | | | |
| 4SF | — | — | 2950 | — | 2950 |
| 4DO | — | — | 2660 | — | 2660 |
| 4VX | — | — | 1480 | 705 | 2185 |
| K5LC | — | — | 2015 | — | 2015 |
| 5ZZ/T | — | — | — | 1365 | 1365 |
| 5WO | — | — | 1125 | 110 | 1290 |
| VK5WO 55 ots. (10 mx.) | | | | | |
| 5FT | — | 955 | 135 | — | 1090 |
| K6SM | — | — | 2760 | 700 | 3460 |
| 6XX | — | — | 2150 | — | 2150 |
| 6DR | — | — | 440 | 245 | 685 |
| K7DK | — | 370 | 3835 | — | 4205 |
| K8DI | — | — | 165 | 1175 | 1340 |
| K9XI | — | — | 3865 | 1235 | 5100 |
| K0GW | — | — | 2915 | — | 2915 |

### VK LISTENERS' SECTION

| | |
|---|---|
| WIA-L2022 | 10190 |
| BERS-195 (VK3) | 7085 |
| L3185 | 3040 |
| L3100 | 6035 |
| L3118 | 2990 |
| L3233 | 4870 |
| L3285 | 1235 |
| L4144 | 4280 |
| L4166 | 3305 |
| L5065 | 4074 |
| L6021 | 11040 |
| L6029 | 815 |

### NEW ZEALAND

.W.—

| ll | 80 | 40 | 20 | 15 | Total |
|---|---|---|---|---|---|
| L1AJU | 55 | 1825 | 8585 | 6440 | 16905 |
| 1ARY | — | — | 5780 | — | 5780 |
| 1DV | — | — | 5755 | — | 5755 |
| 1AWT | — | 1680 | — | — | 1680 |
| 1HW | — | — | 4960 | 2690 | 7650 |
| 1OY | — | 2025 | 630 | — | 2655 |
| 2BAU | — | 5675 | — | — | 5675 |
| 3IS | — | — | 2745 | 2285 | 5030 |
| 4BO | 1315 | 4880 | 2620 | 1980 | 10795 |

HONE—

| ll | 80 | 40 | 20 | 15 | Total |
|---|---|---|---|---|---|
| 1KG | 55 | 1435 | 8220 | 3075 | 12785 |
| 3GS | 190 | 325 | 5975 | — | 6490 |
| 4BO | 55 | 155 | 1588 | — | 1795 |

### ZL LISTENERS' SECTION

| | |
|---|---|
| ZL149 | 9075 |
| ZL190 | 7950 |
| ZL1105 | 2590 |
| Tony E. Magow | 2205 |

### OVERSEAS

C.W.—

#### ASIA

| | points | | points |
|---|---|---|---|
| **EP2BQ** | 770 | **JA6BXA** | 550 |
| JA1ACA | 360 | JA6DGV | 168 |
| JA1QIP | 12 | JA6CLO | 12 |
| **JA2AIR** | 310 | JA7BMK | 528 |
| JA2BNN | 2 | **JA7FS** | 1202 |
| JA2FBA | 252 | JA7YAS | 48 |
| **JA3CWV** | 4144 | **JA0AC** | 1296 |
| JA3DAY | 168 | JA0BFO | 306 |
| **JA5BJC** | 1296 | **VS6BJ** | 969 |
| JA6PY | 132 | 9M2LO | 494 |

#### EUROPE

| | | | |
|---|---|---|---|
| DJ5BV | 1224 | OK3OM | 306 |
| DM2AND | 1360 | OK3CDP | 108 |
| DM2ATD | 696 | ON5AZ | 147 |
| DM3XED | 8 | OZ1LO | 242 |
| **DL7AA** | 2180 | OZ4PM | 250 |
| G2DC | 374 | **OZ2RH** | 754 |
| G3SSO | 1095 | PA0LO | 24 |
| G3WP | Check | **PA0VB** | 80 |
| **G5RI** | 1751 | PA0DC | 42 |
| G6XN | 864 | PA0WAC | Check |
| I1EVK | 30 | SM2COL | Check |
| LA2Q | 24 | SM2CDW | Check |
| **LA7H** | 133 | SM2AGD | 810 |
| LA5HE | 70 | SM3BUS | 18 |
| **OE1RZ** | 1248 | SM3TW | 650 |
| OH1WK | 350 | SM4CLU | 32 |
| OH1XX | 675 | SM5AMF | 400 |
| OH2BH | Check | SM5DKH | 40 |
| OH2BCD | 12 | SM5CBC | Check |
| OH2BQ | 957 | SM5API | 488 |
| OH3AH | 588 | SM5BYG | 416 |
| OH3UO | 468 | SM5BNX | 162 |
| OH5UQ | 340 | **SM5CCE** | 1596 |
| **OH5UX** | 1900 | SM5BGK | 306 |
| OH5VD | 36 | SM7QY | 484 |
| OH6VR | 64 | SM7ANB | 542 |
| OH6UX | 32 | SP3AIJ | 100 |
| OH7NW | 90 | SP6AAK | 24 |
| OK1SM | Check | SP6AAT | 16 |
| OK1ALZ | Check | SP6ANY | 24 |
| OK1US | 2 | SP6RT | 96 |
| OK1NK | 2 | SP6SO | 8 |
| OK1GO | 16 | **SP7HX** | 156 |
| **OK1BY** | 696 | SP8ARY | 45 |
| OK1AFO | 140 | SP9BDH | 120 |
| OK2KGP | Check | TF3AB | 48 |
| OK2QX | 160 | YU1BCD | 198 |
| OK3UL | 378 | | |

#### U.S.S.R.

| | points | | points |
|---|---|---|---|
| UA1KBE | 48 | UB5IU | 95 |
| **UA1KIA** | 392 | **UB5KAI** | 266 |
| UA1NA | 1 | UB5KBU | 12 |
| UA1SP | 72 | UB5KYC | 12 |
| UA1RV | 42 | UB5KCI | 252 |
| UA2KAW | 132 | UB5RS | 52 |
| UA3ND | 24 | UC2AW | 33 |
| **UA3UI** | 1581 | **UC2WJ** | 138 |
| UA3KAO | 528 | UC5ZE | 2 |
| UA3KBO | 910 | UD6BD | 44 |
| UA4ZA | 10 | UD6KAB | 12 |
| UA4KKC | 312 | **UD6KAR** | 64 |
| **UA6KAF** | 304 | UH8DP | 24 |
| UA6KAE | 60 | U18CX | 24 |
| UA6NJ | 4 | **UJ8KAA** | 596 |
| UA6PC | 42 | UL7CH | 190 |
| UA9WS | 56 | UL7GR | 40 |
| UA9HL | Check | **UL7KAA** | 192 |
| UA9WL | Check | UL7KBK | 30 |
| **UA9MX** | 186 | UL7KBB | 48 |
| UA9KCF | 120 | UL7KKB | 48 |
| UA9KTE | 132 | UM8FM | 351 |
| UA9KHA | 5 | UN1CH | 70 |
| UA0AG | 92 | UP2NK | 112 |
| UA0GF | 140 | UQ2GA | 385 |
| UA0KCA | 1891 | UT5BP | 238 |
| **UA0KFG** | 2691 | UV9UF | 42 |

#### OCEANIA

| | | | |
|---|---|---|---|
| **FK8AH** | 572 | **VR2DK** | 8225 |
| **KH6IJ** | 9945 | | |

#### AFRICA

| | |
|---|---|
| **7X2WW** | 8 pts. |

#### NORTH AND SOUTH AMERICA

| | | | |
|---|---|---|---|
| OA4FW | 12 | W6LDD | 6417 |
| **PY2CQ** | 1110 | **WA6EPQ** | 13592 |
| VE1RB | 130 | **K7AL** | 2014 |
| **VE3AU** | 144 | W7BUE | 414 |
| VO1AW | 18 | **W8VSK** | 3212 |
| **W1EVT** | 3240 | W8DGP | 1710 |
| W4RLS | 52 | K9IYK | Check |
| W4SKI/5 | 385 | **WA0EMS** | 528 |
| **W5WZQ** | 1492 | W0CVZ | 230 |

PHONE—

#### ASIA

| | | | |
|---|---|---|---|
| **EP2BQ** | 1045 | JA6PY | 324 |
| **JA2CWX** | 568 | **JA6NP** | 7225 |
| JA3ART | 890 | JA6AD | 3211 |
| JA3CLA | 372 | JA8BB | 24 |
| **JA3CWV** | 1054 | JA9IL | 110 |
| JA3HLJ | 40 | JA0AC | 4 |
| JA4CS | 458 | JA0BNM | 2 |
| JA5AUO | 100 | **VS6AJ** | 540 |
| JA5BJC | 216 | ZC4CN | 144 |
| JA6AL | 84 | 9M2LO | 160 |

#### AFRICA

| | |
|---|---|
| 7X2WW | 2 pts. |

#### EUROPE

| | | | |
|---|---|---|---|
| **DJ6QT** | 3312 | OH3TY | 80 |
| DJ7LD | 204 | OH0NC | Check |
| DM2ATD | 64 | **OK1ADP** | 729 |
| DL1SV | 80 | OK1AHV | 72 |
| DL7AA | 2128 | OZ3SK | 576 |
| DL7KV | 90 | OZ4BH | 64 |
| G3UML | 1080 | **OZ5KG** | 1520 |
| G6XN | 1952 | PA0DEC | 126 |
| LA4LG | 48 | PA0HBO | 344 |
| LA7VE | 168 | SM2BHX | 656 |
| **OD5BZ** | 1161 | SM3BIZ | 632 |
| **OE1RZ** | 2040 | **SM3AGD** | 1606 |
| OH1PN | 8 | SM4CMG | 552 |
| **OH2SB** | 1386 | SM7MS | Check |
| OH2XA | 496 | SP7HX | 16 |

#### U.S.S.R.

| | | | |
|---|---|---|---|
| UA3KBD | 287 | **UJ8KAA** | 810 |
| UH8BO | 2 | | |

#### NORTH AND SOUTH AMERICA

| | | | |
|---|---|---|---|
| **HP1JC** | 1089 | **K6ERV** | 5700 |
| **OA4KY** | 3320 | W1PYM/6 | 598 |
| PY2SO | 8 | W7BTH | Check |
| WA5ALB | 36 | | |

#### OCEANIA

| | |
|---|---|
| **KH6IJ** | 5551 pts. |

#### OVERSEAS LISTENERS' SECTION

| | | | |
|---|---|---|---|
| DE13864 | 243 | JA1-5160 | 946 |
| DE15431 | 48 | JA3-2325 | 60 |
| DE15440 | 200 | JA7-1535 | 272 |
| DEA6767 | 78 | JA8-1478 | 870 |
| DEA26155 | 378 | JA0-1320 | 682 |
| DEA27048 | 858 | Atsushi Oosumi | 1280 |
| DL9-286 | 1404 | SM2-3706 | 936 |
| GW7796 | 328 | UA9-2847/UA3 | 232 |
| HE9FMO | 900 | WPE4IHI | 96 |
| I1-11587 | 24 | YU3-RS-523 | 396 |
| JA1-4665 | 96 | | |

CRYSTAL PYE DIVISION

Manufacturers of Quartz Crystals for Frequency Control and Crystal Filters for Highly Selective Circuits, Announce:—

NEW LOWER PRICES FOR CLOSE TOLERANCE GOLD PLATED CRYSTALS FOR AMATEUR APPLICATIONS

- 1.8 Mc/s to 14.999 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. **Amateur net £2/8/6 each including tax.**
- 15 Mc/s to 47.999 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. **Amateur net £2/10/6 each including tax.**
- 48.0 Mc/s to 61.0 Mc/s ± 0.005% in Style "D" holders, ½in pin spacing. **Amateur net £2/16/3 each including tax.**
- 100 Kc/s ± 0.005% in HC13/U holders, ½in pin spacing* **Amateur net £4/10- each including tax.**
- 1 Mc/s ±0.005% in Style "D" holders, ½in pin spacings* **Amateur net £4/10/- each including tax.**
- 455 Kc/s nominal Crystals for Filter applications in Style "D" or "E" (B7G) holders. **Amateur net £4/10/- each including tax.**

* Specially designed for Crystal Calibrator purposes.

**Many other types and tolerances are available from our standard production. Please consult us on your Crystal requirements.**

**PYE PTY. LTD.**

*CRYSTAL DIVISION*

**Clarinda Road, Clayton, Victoria. P.O. Box 105, Clayton. Tel.: 544-0361.**
**State Offices in Adelaide, Brisbane, Hobart, Perth and Sydney.**

**A. C. E.**

AMPLIFICATION

COMMUNICATION

ELECTRONICS

★★★★★★★★★★★★★★★★★★★★★PHONE 51-384

# RADIO

636 KING STREET, NEWTOWN—51-7008

# 136 VICTORIA ROAD, MARRICKVILLE — 51-3845

## B.S.R.

4-TRACK DECK

$35.50 £17/15/-

2-Track, 3-Speed.

$35.50 £17/15/-

4-Track, 3-Speed. Mono or Stereo.

$45.25 £22/12/6

4-TRACK. 3-SPEED. 3 HEADS.

$49.50 £24/15/-

BRADMATIC HEADS

Latest ½-Track. HI FI.

$9.50 £4/15/- pair

**4-TRACK or STEREO**

| Record play back | erase |
|---|---|
| $11.50 | $5.50 |

## THE NEW COLLARO TAPE DECK

Takes 7in spool.

3 speeds: 1⅞, 3¾, 7½ i.p.s.

2-track, $44.

4-track, $48.

Write for particulars.

## TRANSISTOR POWER SUPPLIES

12v. D.C. Input. 300v. 150Ma. Output plus 150v. Output.

$23.75 £11/17/6

12v. D.C. Input. 400v. 150Ma. Output plus 200v. Output.

$29.75 £14/17/6

240v. A.C. INPUT

| 9v 200 MA | 12-15-22v 500 MA |
|---|---|
| $4.75 | $7.75 |

## VARY. A.C.S.

240-270V 50 cycle 5 amp.

Provide infinitely variable AC voltage

$29.50 £14/15/-

2½ Amp as above

$23.50 £11/15/-

10 amp. as above.

$45.75

## PLAYMASTER 106 AND 107

Feb. and March Elect, Aust.

106

WIRED AND TESTED. $88.75

107

WIRED AND TESTED. $79.00

## ELECTRIC GUITAR

| | |
|---|---|
| Pickup Units | $8.75 |
| Accordion Pickup Units | $8.75 |
| Harmonica Pickup Units | $1.95 |

Post., N.S.W. 40c; Interstate. 75c.

## TRIO W26 STEREO-TUNER AMPLIFIER

12 watts per channel.

Mag. P.U., Crystal P.U., Tape In-Out, Broadcast, Stereo, S.W. Mono.

$138.00 __ __ __ £69

SEE TRIO. ADVERT.

## Transistor-Ignition HI-SPARK

Simple installation.

38 K.V. output.

Complete. Tested.

Negative earth.

$33.50 £16/15/.

Positive earth.

$41.50 £20/15/-

State voltage and polarity.

Post., N.S.W., 75c; Interstate, $1.25.

## CITIZENS BAND

27.240 Megs.

10 Transistor Transceivers.

100 M.W. output.

$45.00

1 watt. 15 transistor, with squelch provision for two channels. Range to 10 miles under ideal conditions.

$80.00 £40 each

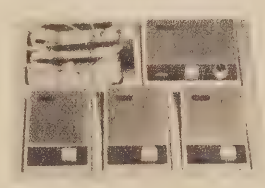
## INTER. COM. UNITS

2 Station Transistorised

$11.50 £5/15/-

4 Station, including Master

$20.25 £10/2/6



## New Telephone Amplifier

Transistorised.

$11.50 £5/15/-

Post 35c.

## T.V. TUNERS

New 10-channel Tuners.

$15.00 £7/10/.

Post 75c.

## LATEST 4-SPEED PLAYERS

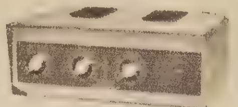
| | |
|---|---|
| 240V A.C. Mono | $11.50 |
| 240 A.C. Stereo | $17.00 |
| Battery Mono | $19.50 |
| Battery Stereo | $21.50 |
| Battery Mono 45 r.p.m. in Cabinet | $9.25 |

Post., N.S.W., 75c; Interstate, $1.25.

*Send for full details on Radiogram Chassis, TV and Amplifiers.*

## AMPLIFIERS

Public Address Range 240V-AC



**MINIATURE P.A. AMPLIFIER. 15 WATTS OUTPUT.**

| | |
|---|---|
| Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL.84 output | $39.50 |
| 30 Watt. As above EL34 P.P. | $53.50 |
| 40 Watt. As above EL34 P.P | $79.50 |
| 60 Watt. As above EL34 P.P. | $98.50 |

LINE OR VOICE COIL TRANSFORMERS.

MULLARD HI-FI RANGE.

| | |
|---|---|
| 5/10 with pre amp base and treble boost. Ultra Linear output | $43.50 |
| 5/20in. As above | $65.50 |

## BATTERY-AC OPERATION

| | |
|---|---|
| 6 valve 6v plus 240v-10 watt | $55.50 |
| 7 valve 12v plus 240v-12 watt | $59.75 |
| 7 valve 12v plus 240v-25 watt | $71.75 |

## TRANSISTOR P.A. AMPLIFIER C.A.-512

12VDC Operation.

Output 20 watts.

Current consumption at max. output, 2.2 amps.

Input. High imp. mic. Also 600 ohms and tape.

Independent gain controls.

Output: Imp. 4-8-16 ohms.

Freq. Response: 200 cps—6000 cps.

Dimensions: 2in x 6¼in x 8½in.

Complete with instruction book with circuit. All plugs.

PRICE $57.50

## DYNAMIC MICROPHONES

| | |
|---|---|
| DM-391 HI-Imp | $3.50 |
| DM-175 HI-Imp | $4.75 |
| DMS-3 HI-Imp | $5.50 |
| DM-305. 600 ohms or HI-Imp. Suitable stand mounting | $9.75 |
| DM-304. Dynamic Cardioid. 50 ohms or HI-Imp. Suitable stand mounting | $15.75 |
| D.M. 307 HI-IMP. | £7/10/- |
| CM-10 Crystal HI-Imp. Suit stand mount. | $5.06 |

Post., N.S.W., 25c; Interstate, 35c.

## WIDE RANGE LIGHTWEIGHT STEREO PICK-UPS

| | |
|---|---|
| Ceramic Units, Sapphire Styli | $7 |
| Diamond Styli | $10 |
| Universal Ceramic Stereo Cartridge, Sapphire Styli | $2 |
| Diamond Styli | $6 |

## NEW WIDE RANGE SPEAKERS

15 ohm. Twin Cone

| | |
|---|---|
| 8in | $7 |
| 12in | $7 |
| 5in | $4 |
| 5in Tweeter | $3 |
| 4in Single Tweeter | $2 |
| 12in Heavy Duty 20 watt | $15 |

## P.A. REFLEX HORN

WITH UNITS

| | |
|---|---|
| 5 Watt 8 ohm | $14 |
| 10 Watt 8 ohm | $26 |
| 35 Watt 15 ohm | $18 |

N.B.: As these are American ratin divide the wattage by 2.

## STEREO RECORD CHANGERS

1965 model. 4-speed.

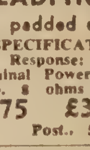
$21.50 £10/15/-

De Luxe Model.

Fully machined and balanc Heavyweight turntable. Cera cartridge.

$27.50 £13/15/-

Post. N.S.W., $1.25; Interstate, $1



## STEREOPHONIC HI- HEADPHONES

With padded earpieces

SPECIFICATION:

Frequency Response: 25-17,000 c

Nominal Power 1 watt.

V.C. Imp. 8 ohms each chann

$7.75 £3/17/6

Post., 50c.

## PHILIPS DISC JOCKEY

4-speed Players.

6V, D.C. OPERATION.

MONAURAL CRYSTAL HEA

$9.75 £4/17/6

STEREO

$11.75 £5/17/6

Post., N.S.W., 75c; Interstate, $1.

## MORSE KEYS

New lightweight, fully adjustable u

95c

As above with buzzer. Complete Morse practice set.

$1.65

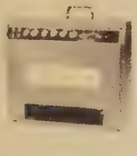
**A.** AMPLIFICATION
**C.** COMMUNICATION
**E.** ELECTRONICS

★★★★★★★★★★★★★★★★★★★★★ PHONE 51-3845

# RADIO

636 KING STREET, NEWTOWN—51-7008

# 136 VICTORIA ROAD, MARRICKVILLE — 51-3845



## GUITAR AMPLIFIERS

10-Watt, Two Channel, with Twin Cone Speaker, $51.50 (£25/15/).

14-Watt, 4 Inputs, Bass and Treble Boost. 2 Twin Cone Speakers, $59.50 (£29/15/).

17-Watt. Four-Channel. Bass and Treble Boost. Two Twin Cone Speakers, $73.75 (£36/17/6).

### 35 WATT

4-Channel, Bass and Treble Boost. 4 Twin Cone Speakers, $105 (£52/10/).

60-Watt, 2 Unit
4-12in Auditorium Speakers,

**$171.75 £85/17/6**

Vibrato with foot control and 2 pre-set controls for frequency and intensity. $10.56 (£5/5/) extra on above models.

### 14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels, Bass and Treble Boost. Foot Vibrato Control included.

**$163.50 £81/15/-**

### SLAP BASS OR BASS GUITAR 40 WATT AMPLIFIER

4 Input Channels, Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

**$145.75 £72/17/6**

### PIGGY BACK GUITAR AMPLIFIER

| | |
|---|---|
| 30 Watt | $79.75 |
| 45 Watt | $99.75 |
| 60 Watt | $119.75 |

4 Inputs. Bass and Treble Boost. Vibrato if required. $10.50 extra.

### TAPE ECHO UNIT

Suits any Guitar amp. without any alteration.
JUST PLUG IN

**$139.50**

### REVERBERATION PRE AMPLIFIER

Suits any Guitar amp.
No changes necessary.
JUST PLUG IN
Completely transistorised.

**$58.75**

## PLAYMASTER 4 STEREO AMPLIFIERS

Push-Pull. 8 Watt per Channel. Bass and Treble boost and Cut. Wired and Tested.

**£38/10/- $77.00**

### TRANSISTOR CAR RADIO

Push-button operation. High sensitivity. Tailored to fit most modern cars. 6v or 12v operation — state voltage. Polarity and speaker size.

**$58.00 £29** Complete

### NEW RECORDING TAPE

| | £ | s | d |
|---|---|---|---|
| 3in. Mylar LP 300ft. .. | | 10 | 6 |
| 5in. Mylar LP 900ft. .. | 1 | 0 | 0 |
| 5in. Mylar DP 1200ft. .. | 1 | 5 | 0 |
| 5¾in. Mylar LP 1200ft... | 1 | 5 | 0 |
| 5¾in Mylar DP 1800ft | 1 | 17 | 6 |
| 7in. P.V.C. 1200ft. .. .. | 1 | 5 | 0 |
| 7in. Mylar LP 1800ft. .. | 1 | 17 | 6 |
| 7in. Mylar DP 2400ft. .. | 2 | 10 | 0 |
| 10½in. Mylar LP 3600ft. . | 3 | 15 | 0 |

Post 2/6 per Spool.

### P.A. SPEAKERS
8 WATT

8in Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

**$13.50 £6/15/-**

In Double Ended Flares.
Duolateral Coverage.

**$14.50 £7/5/-**

Line Output Transformers to suit, $1.75 (17/6) extra.

### P.A. SPEAKER DRIVER UNITS

American Rating. 30 Watts.
Voice Coil 16 ohm.

**$21.50 £10/15/-**

15 Watt Rating.

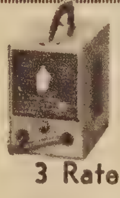
**$15.75 £7/17/6**

REFLEX HORNS TO SUIT.

**$21.50 £10/15/-**

## *WEEKEND — HOLIDAY — EVENING DEMONSTRATIONS AT COLLAROY*

PHONE XW5956 FOR APPOINTMENT TO TEST STEREO GUITAR AMPLIFIERS AND TELEVISION.



## BATTERY CHARGER

240 Volt A.C. Operation

### 3 Rate 6V, 12V TRICKLE CHARGE

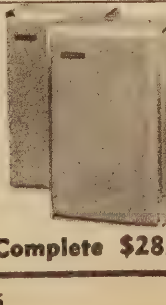
Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

| STANDARD | |
|---|---|
| 2 amp. 6V, 12V, TRC .. | $11.50 |
| 3 amp. 6V, 12V, TRC .. | $12.25 |
| 4 amp. 6V, 12V, TRC . | $15.25 |
| 5 amp. 6V, 12V .. .. . | $15.95 |

Post., N.S.W. 75c, Interstate $1.25

| DE LUXE | |
|---|---|
| 1½ amp., 6V-12V .. .. | $9.75 |
| 3 amp. .. .. .. .. .. | $16.75 |
| 4 amp. .. .. .. .. .. | $19.75 |
| 6 amp. .. .. .. .. .. . | $21.75 |
| 10 amp. .. .. .. .. .. | $27.75 |

Rail or Air Freight on.



Complete $28.50

## PLAYMASTER BOOK SHELF UNITS

To R, TV & H specifications.
Mountain Ash, Maple, Walnut or Teak Formica finish.

*ALSO CABINETS ONLY*

To suit 6", 8" and 12" speakers
$12.50 $15.50 $17.50

REVERBERATION UNIT
ACE RADIO MARRICKVILLE
INPUT
OUTPUT

## REVERBERATION UNITS

Latest design to suit organs, stereo, guitar, any hi-fi equipment.

**£2/17/6 $5.75**

Post. 3/6.

## ELEGA REVERB. SPEAKERS

Automatic addition of reverberation to any existing amplifier.
Handles 12 watts.

**£12/15/- $25.50**

### CO-AXIAL SPEAKERS C.S-30. 12"

V.C. 16 ohm. Cross over 3,000 cycle. Frequency range 30 to 20,000 cycles. Rated 20 watts.

**£13/19/6 $27.95**

### C.S-20. 8"

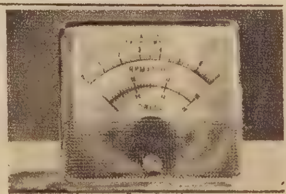
V.C. 16 ohm. Cross over. 3,000 cycle. Frequency Range 40 to 20,000 cycles. Rated 8 watts.

**£7/19/6 $15.95**

## HORN TWEETER CT-3

2,000-20,000 Response.
20 Watts Power.
Sensitivity 110 dbw.
Weight 1¼lb.

**£4/9/6 $8.95**



### MULLARD-A.C.E. TACHOMETER

Wired and tested.

**$20.75 £10/7/6**

"Electronics Australia," July, August issue. State max. revs., voltage, polarity cylinders.

METER ONLY

**$6.75 £3/7/6**

INCLUDING DWELL. ANGLE FACILITY

**$23.25 £11/12/6**

Post., N.S.W., 50c; Interstate, 75c.

**A.** AMPLIFICATION
**C.** COMMUNICATION
**E.** ELECTRONICS

★★★★★★★★★★★★★★★★★★★★★ PHONE 51-3845

# RADIO

636 KING STREET, NEWTOWN—51-7008

**K 20** CT330 **K 20** CT500

### 220S 4000 O.P.V.

D.C. Volts 5, 25, 125, 500, 2500. A.C. Volts 10, 50, 250, 1000. Current: 250uA, 250mA. Resistance: 0-10K, 0.1 Meg.

**£3/19/6 Post 5/-**

### C.T.330 20K.OPV

D.C. Volts, 6, 6, 30, 120, 600, 1200, 3000, 6000. A.C. Volts, 6, 30, 120, 600, 1200. D.C. Current, .06-6, 60, 600mA. Resistance, 6K, 600K, 6meg., 60meg. D.B. minus 20 to plus 62. 5 Ranges. Specially suitable for transistor use. **$15.95** Post., 50c.

### C.T.500 20K.OPV

D.C. Volts, 2.5, 10, 50, 250, 500, 1000. A.C. Volts, 10, 50, 250, 500, 1000. D.C. Current, .05, 5.50, 500mA. Resistance, 12K, 120K, 1.2 meg., 12meg. D.B. minus 20 to plus 62.

**$13.25** Post., 50c.

### S.E.550 100K.OPV

D.C. Volts, .5, 2.5, 10, 50, 500, 1000. A.C. Volts, 2.5, 10, 50, 250, 1000. D.C. Current, 10uA, 2.5, 25, 250mA, 10 amps. Resistance, 2K, 200K, 2M, 20M. D.B., minus 20 to plus 62.

**$20.75** Post., 75c.

### P.T.34 1000.OPV

D.C. Volts, 0, 10, 50, 250, 500, 1000.
A.C. Volts, 0, 10, 50, 250, 500, 1000.
M.A. 1-100-500 RESISTANCE.

**$5.25** Post., 50c.

### 200H. 20K.OPV

D.C. Volts, 5, 25, 50, 250, 500, 2500. A.C. Volts, 10, 50, 100, 500, 1000. D.C. Current, 50uA, 2.5, 250mA, Resistance, 6K, 600K. Capacitance, 2 D.B. Ranges.

**$10.50** Post., 50c.

ALL PRICES NET, INC. S.-TAX.

### T.E. 40. V.T.V.M. MILLIVOLTER

10 Ranges. 1 MV to 300 V RMS. 10 Ranges, D.B. minus 40 to plus 50 DBM.

**$44.50**

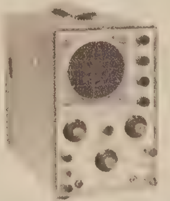
### V.T.V.M.

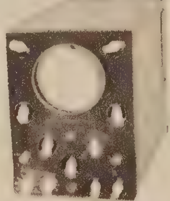
27 Ranges, A.C. Powered.
D.C.V. 0, 1.5, 5, 15, 50, 150, 500, 1,500.
A.C.V. 0,1.5, 5, 15, 50, 150, 500, 1,500 R.M.S.
A.C.V. P. to P. 0, 1.4, 4, 14, 40, 140, 400, 1,400, 4,000.
Resistance, 1 ohm to 1,000 megohm.
D.B. Minus 10 D.B. to plus 65 D.B.

**$42.50**
Post., $1.

H.V. Probe to 30 KV. $7.75.
T.M.K. Units, $53.50.

## TEST EQUIPMENT





## WIDE BAND OSCILLOSCOPE

5 Meg. Bandwidth. Push-pull vertical and horizontal Amplifiers. 8 position, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard-time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.

**3-inch $99.75; 5-inch $111.50**

T.O.2 TV portable service unit 2" oscilloscope $65

### 4 CHANNEL MICROPHONE MIXER PRE AMPLIFIER

**$7.75**
Post., 50c.

### TRANSISTORISED VARIABLE POWER SUPPLY

Range to 20V, 200MA

**$18.75**
Post., 50c.

### MINILAB 7in 1 MULTIMETER

**$16.75**
Post, 50c.

### STEREO PRE AMPLIFIER

240 V. A.C. Power.
To suit magnetic P.U. tape or microphone.
Response: 20 to 20,000 cycles.
Gain 60 D.B.

**$15.50**
Post., 50c.

### G.D.O. UNITS

Leader, 810. 6-Band. 2 Meg. to 260 Meg. Nuvistorised. 240 V.A.C. Operation, Modulated. Calibration. Accuracy 2 per cent.

**$41.50**

T.E. 18 Lafayette, 8 Bands. 360 K.C. to 260 Megs. 240 V.A.C. operation.

**$39.50**

Post., N.S.W., 50c; Interstate, 75c.

### LEADER SWEEP & MARKER GENERATOR SMG 532

TV and F.M. 2 to 270 Megs. 5.5 Meg. Crystal for TV sound. Sweep width to 12 Megs. Model 531.

**$170.00 £85/-/-**

Post., N.S.W. $1.50; Interstate, $2.50

### PANEL METERS

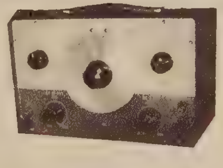
### EDGE TYPE

1 mM. Scaled, S. Meter, Stereo Balance. Tuning. **$2.50**

### 2" 3" 4" PLASTIC COVERED PANEL UNITS

Latest P series ¾in Barrel 50mmA, 200mmA. 1mA, 10 mA, 500mA, 1 Amp, 10 Amp, 15V. 500V.

**From $3.00**



### T.E. 20 RF SIGNAL GENERATOR

Freq. 120KC—260MCS in 6 bands.
Output (RF)—High 100,000uV max. Low 100uV max.
Output (Audio)—400 cps approx. 8V.
Modulation — 400 cps internal.
Operation — 240V AC.
Dimensions 7in x 10½in x 5½in.
Weight — 9lb.
Complete with Instruction Book circuit.

**$26.50 £13/5/-**

T.E. 20D, sig and marker gen. 120KC to 500 megs. With 5.5 meg. crystal.

**$39.50**

Post., N.S.W., 75c; Interstate, $1.25.

### LEADER SIGNAL GENERATOR LSG 11

240v A.C. Powered.
6 Band, 120 Kc to 390 Megs.
Provision for Crystal.
An Ideal TV Marker Generator.

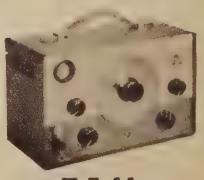
**$29.50**

Post., N.S.W., 75c; interstate, $1.25

### SIGNAL INJECTOR

Transistorised. Fountain Pen-size Unit for Signal Tracer in Radio TV and Amplifier Service.

**$4.75**
Post., 25c.



### T.E.46 RESISTANCE-CAPACITANCE

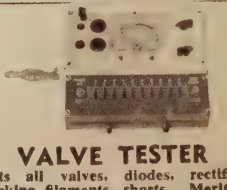
Bridge and Analyser.
Capacity 20 pfd to 2,000 mfd.
Resistance 2 ohm to 200 megs.
Also tests power, factor, leakage impedance, transformer ratio, insulation resistance to 200 megs. a 600V.
Indications by eye and meter.

**$51.95**

### T.E.22 AUDIO GENERATOR

Sine and Square Wave.
20 Cycles to 200 K.C. 4 Bands
Frequency response plus/minus 1.5 D.B.
60 Cycles to 150 K.C.
Output impedance 5,000 ohm.
Output volts, 0 to 7.

**$44.25**



### VALVE TESTER

Tests all valves, diodes, rectifiers checking filaments, shorts. Merit o direct reading. Good-bad meter Complete wi·h tube chart.

**$26.75**

Post., N.S.W., 25c; Interstate, $1.25

### T.E. 50.—99—5011

Checks. Nu Vistas, Compactrons etc.

**$34.25**

# LISTENING AROUND THE WORLD

**Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.**

## WRUL Announces Expansion Plans

Radio New York World Wide, station WRUL announces that the Federal Communications Commission has given approval for installation of new transmitting plant, to give the station a combined transmitter power of over 700KW.

The announcement by Radio New York Vorld Wide, states that this will make VRUL the world's largest commercial station. The station operators, The Internaional Educational Broadcasting Corporaion, made the announcement under its ıame Radio New York World Wide, and aid the new transmission plant would be ocated on a 735-acre tract of land in New Jersey, near Chatsworth. The new lant will include two 250KW, one 100KW nd two 50KW transmitters, which will eam programs direct to Europe, Africa nd Latin America through curtain and hombic antennas, which will be the most ıodern in the world. The designers of the quipment have done extensive work for ıe Voice of America, Radio Liberty and ładio Free Europe.

The 700,000 watt plant will have an ffective radiated power of 5 million watts nd is expected to cost in excess of $20-illion. This price includes the cost of the ation from Metro-Media the present operators. This will represent a total investıent of over $4.5 million, and this is the cond step in the expansion plans, for February the WRUL authorities anounced they had contracted to lease for ) years the entire third floor of the uilding at 485 Madison Avenue, home of ıe Columbia Broadcasting System. This ase will enable the station to have the ost modern studio and transmitting equipıent.

Radio New York World Wide at present oadcasts 17 hours a day on each of e transmitters in English and Spanish, ıt plans to add Portuguese in a few eeks, and when the new transmitters open 1967 to add programs in German and rench.

### RWANDA USES 6050KC

Reception of Radio Rwanda is being ported by readers, with the station beg heard to sign off at 2100GMT on 50KC. This station should not be consed with the Deutche Welle relay at igali, in Rwanda. The Radio Rwanda ıtion which has been reported by Ernie oore, of New Farm, Brisbane, and others the station operated by the Republic of wanda, at Kigali, and uses 50KW on 50KC. Programs are in local dialects, t the sign off announcement at 2100 is French. The signals in New Zealand are r, but major interference is from the C, London, with the European service this frequency, and to a lesser degree m a home program of Radio Moscow.

### VRH6-VRH7 IN OPERATION

The Fiji Broadcasting Commission has t into service two new 500 watt transtters, and these are now on the air on H6 on 5980 and VRH7 on 6005KC. ese two transmitters are on the air 1800-0400 GMT, which is 6 a.m. to 4 p.m. Suva time. The VRH6 station carries the English program and the VRH7 the vernacular transmissions, which are also carried in the 60 and 90M bands on the 10KW transmitters which have been in operation for some years. The frequency of VRH6 is to be moved from 5980 to 5955KC shortly, the frequency allocated to the station in the international frequency allocation plan.

The new medium wave station in Suva, VRH11 on 1320KC, is to be increased in power to 1200 watts, the power boost being of 400 watts. The station Chief Engineer, Mr T. C. Agar, is surprised at the way the signal of VRH11 is getting out since the aerial is a short flat-top above Broadcasting House in Suva.

### ZYR56 VERIFIES

A verification letter in English has been received from ZYR56, Radio Excelsior in Sao Paulo, Brazil, which was heard when on an all-night transmission on New Year's Eve using its frequency of 9585KC.

The verification letter gave the address of Radio Excelsior as Rue das Palmeiras 335-SLJ, Sao Paulo, Brazil. The station stated in their letter that they were proud to know that "our station is so well heard abroad in your distant country." Verification is signed by Lula Margarido, Assistant to the Manager. The verification letter, sent airmail, listed no frequencies of other transmitters in operation.

### ANDORRA ON 5995KC

The reception of Radio Andorra signals on 5995KC continues to be reported around the world, and it would seem that the station is now using this frequency for a relay of its home program, and not the International Service, as has been the case in the past. Radio Andorra has been heard in New Zealand from 0730GMT following the sign off of the Voice of America in Greenville, using the same frequency. The station is reported from Europe as being heard at 1000 and also at 1200GMT. The International Service, which included programs in French, Spanish and English, has been carried on this frequency in the past, but the only announcement we have heard is the station identification in French. This station, in the tiny Principality of Andorra, has 25KW on 5995KC and its BC station on 998 KC has 400KW of power.

### LAOS STATION REBUILT

A fire last year destroyed the radio station known as the Voice of Laos, but the station has now been rebuilt and is being reported again with the program of Radiodiffusion Laos. The station is reported on 6112 and 5115KC, but gives its frequency announcement as 6130KC. The broadcasts come from its studios in Vientiane, is on the air 0000-1500 and has French 0130-0400, 0500-0800 and 1315-1500 GMT. The station verified our reception some years ago by a letter when the broadcasts were then on the announced frequency of 613KC and located also in Vientiane.

## PIRATE BROADCAST STATION FOR N.Z. COAST

An Auckland company has announced plans to operate a "pirate" commercial radio station, to be located outside territorial water of the coast of Auckland City, in an attempt to break the broadcasting monopoly of the New Zealand Broadcasting Corporation.

The Act of Parliament under which the NZBC operates allows the licensing of private commercial radio stations in New Zealand, but the Corporation has consistently refused to grant any licences to private companies wishing to establish a commercial broadcasting service. The reason given for refusal has always been the same, namely that the area designated in the application is being provided with a radio service by the NZBC, although these areas often have no alternative service.

An Auckland company has been formed to operate the first off-shore commercial radio station. The station will broadcast from a point in the Hauraki Gulf, outside Auckland, and should have a listening audience of nearly a million listeners within its range. The promoters of the venture plan to operate the station from 1745-2200 and 0100-0730-GMT (5.45 to 10 a.m. and 1 to 7.30 p.m. local time) for the commencement of the transmissions and then extend the service to 24 hours each day.

The station will have a "popular" music format, run by disc jockeys. It is proposed to have the station in service by October, as much of the equipment is now on hand, and the vessel is in the conversion stage.

According to a press report the matter was referred to the Deputy Director of the NZBC who had no comment to make on the move, while a spokesman of the Radio Division of the Post Office in Wellington said that a licence for private radio stations would not be granted to an applicant unless a warrant had first been obtained from the NZBC. He agreed the Post Office itself could do little about a pirate radio station working outside the three-mile limit, and this would be a matter for the Government; even so, it was pointed out such a station would have difficulty in finding a frequency free of interference, as most frequences were already in use.

### SOUND PROJECTORS

Cinevox Prefect 16mm in good working order. 240v operated, complete with speaker and amplifier.

**$115.00**

### CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

**$1.25 each. Post 10c**

### REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder.

**$1.85 each**

Post: N.S.W., 30c; Interstate, 40c.

### PMG TYPE TELEPHONES

Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line. Complete with 660ft wire.

**$23.00**

(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

### AERIAL CAMERAS

F.24 Mark IV 2.9 Lens, stops 11, 8, 5.6, 4, 2.9.
With 3in x 8in F1 Dallmeyer Lenses complete with wooden case.

**$39.00**

50c Cartage to Rail. Freight payable at nearest attended railway station.

### SHIPS' CLOCKS

(No bell). Smith's 8-day, fully jewelled. Original cost $120. Special 7in brass $25. 10½in Seth Thomas splash-proofed bakelite

**$30**

Post N.S.W., 70c; Interstate, 95c.

### TRANSFORMER

AGC. Single phase, 1.75 Kva primary volts, 100-200, 110-220, 120-140, 130-260, secondary 2,200 1,700 at FL. PF equals 1.0. $35.00

### 12 CREED TELEPRINTER

Tape printers model 47.R, 240 Volts operated.

**$35.00**

### TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile). $7.00 per coil.
Post, N.S.W. 70c; Interstate $1.20.

### 3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

### 2-WAY RADIO

NUMBER 22 (AUST.)

Untested without meter or leads, with power supply less relays. $15.00. 50c cartage to rail. Freight payable at nearest attended railway station.

### A.W.A. 6 or 12 volt

Transmitter 70 to 80 megacycles, $15, 240 volt power supplies for receivers, $15. 50c cartage to rail. Freight payable at nearest attended railway station.

### FRACTIONAL 240 VAC MOTORS

1/25 h.p., new, with coupled 2-speed gearbox. 1425 and 300 r.p.m. Ideal for rumbler, etc.

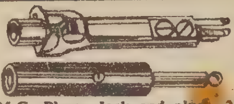
**$20**

Post N.S.W., 70c; Interstate, 95c.

### AWA OSCILLOSCOPE

Calibrated with delay time base. 5in, 240 vac., perfect.

**$195.00**



P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

### NIFE CELLS

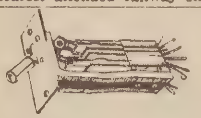
1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

**$1.00 each**

Post, N.S.W., 25c; Interstate, 35c.
1.2 volts 15 AH, 8in x 4in x 2in, $1.95.
2.4 volt 10 AH, 6in x 2½in x 2in. $2.50.
Post, N.S.W., 30; Interstate, 40c.

### PERSPEX

Slightly domed shape, 16in x 12in, $1.55. 2ft 6in x 18in tapering to 6in, $1.75. 2ft 6in x 2ft, $2.45. Domed approximately 3ft 6in x 2ft, $5.50.
50c cartage to rail. Freight payable at nearest attended railway station.



P.M.G. TYPE KEY SWITCHES.
45c each. Post, 15c.

## VALVES

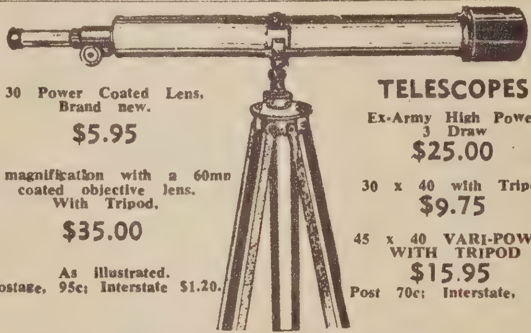
### BRAND NEW

IN CARTONS.

Special discount for quantity

| | | | |
|---|---|---|---|
| 6SN7GT | 95c | 6AG5 | 50c |
| 89 | $1.00 | X61M | $2.20 |
| 12SA7 | $1.25 | CV850 | $1.50 |
| 6H6 | 45c | 18H6G | 30c |
| 41 | $1.25 | 832 | $5.00 |
| 5U4G | 95c | 6F13 | 75c |
| 77 | $1.00 | 6AK5 | $1.75 |
| VR150-30 | $1.00 | 6X4 | $1.00 |
| | | 6F8 | 75c |
| 5CPI | $3.05 | 6N7 | $1.00 |
| EF50 | 35c | 12SK7 | 50c |
| 6U7 | 75c | VR1120 | 50c |
| V1103 | $1.00 | VR118 | 75c |
| VH120 | 75c | VR65 | 25c |
| 1L4 | $1.0 | 6R7GT | 50c |
| 5Y3 | $1.25 | VT4C | 75c |
| 6C4 | 50c | AU5 | $1.00 |
| CV2184 | $2.25 | 80 | $1.25 |
| 6AK5 | $1.5 | 6AK5W | $1.50 |

PLEASE ADD POSTAGE ON ALL ARTICLES.



30 Power Coated Lens, Brand new.

**$5.95**

60 magnification with a 60mm coated objective lens. With Tripod.

**$35.00**

As illustrated.
Postage, 95c; Interstate $1.20.

### TELESCOPES

Ex-Army High Power 3 Draw

**$25.00**

30 x 40 with Tripod

**$9.75**

45 x 40 VARI-POWER WITH TRIPOD

**$15.95**

Post 70c; Interstate, 95c.

### HIGH STABILITY RESISTORS

I.R.C. brand new ½w., 1w, 2w, tolerances between 1 and not exceeding 5% including 100, 360, 560, 750, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 40c each, 50 assorted different values for only

**$3.75 Post 15c.**

### GOOSE NECK LAMP

NEW. IDEAL FOR DESK or WORK BENCH. Adjustable shade, strong metal lacquered base and frame. Height 18in. Complete with lead.

**$1.25**

Post and packing, $1.00.

### THEODOLITE

Cooke Troughton and Simms, London. Microptic. Tested. Complete with Tripod. $275.00.

### 522 TRANSCEIVERS

100 to 150 m/cs.

**$35.00**

### TR1934 TRANSCEIVERS

100 to 125 m/cs.

**$33.00**

### GENUINE VARIACS

0-115 V.A.C. 18 Amps, $29 each, or couple two together for 240 V.A.C.

**The two for $45**

**Genuine American Zenith Variacs**

0-115 V.A.C. 7.5 Amps, $19.50 each or couple two together for 240 V.A.C.
The two for $36.
50c cartage to rail. Freight payable at nearest attended railway station.

### C.M.A. CABLE

240 volt 3/.036 black, new and perfect. 100 yds. rolls, $3.00, 6 or more.

**$2.50 a roll**

30c cartage to rail. Freight payable at nearest attended railway station.

## MICROMETERS

Brand new Goodell-Pratt. 0 to 1in, $7.50; Slocombe, 1in-2in, $7.85; Starrett 1in-2in, $9.85.
Post, 32c.

CHOKES, 7.5H, 60mA .. .. 95c
VIBRATORS, 6 volts, 7-pin, 75c each.
UNISELECTORS, 4 BANK HOMING TYPE .. .. $4.00
INVERTERS, 26v-115v 2Kw 400 cycle .. .. .. .. .. .. $9.50
HAND MICROPHONES, with Press-to-Talk Switch .. 95c ea.
Post, N.S.W., 25c; Interstate, 30c.
INSTRUMENT TRIPODS, sturdy wooden frame, Telescopic. Extend to 4ft 6in .. .. .. $13.00
SELSYN MOTORS MAGSLIP Mk. II .. .. .. .. .. $5.25 ea.
No. 19 2-way radios, with hand set, power supply, leads. $35.00
Meggers, bridge type, complete and tested .. .. .. .. $75.00
EVERSHED and VIGNOLES, 500 volts.

### H.T. TRANSFORMERS

2,000/0/2,000 volt. Primary 28 volt 50 cys. rated at 1.75 Kva. Ideal linear amplifier, etc.

**$27.00**

### BINOCULARS

PRISMATIC. Coated Lenses. Brand new. Complete with case.

| | |
|---|---|
| 8 x 30 | $19.50 |
| 7 x 50 | $26.50 |
| 10 x 50 | $27.50 |
| 12 x 50 | $28.50 |

Post, N.S.W. 70c; Interstate, $1.20

SPECIAL ARMY RELEASE.

### TELESCOPES

ALL LENSES "ASTRONOMICAL" QUALITY.

**General and Marine Use**

4 x 40 Genuine HANDLEY. Cost $60.00. Our Price, $6.50.
7 x 40 GENUINE OTWAY ANGLE TELESCOPE. Cost $90. Our Price .. .. .. .. .. $9.85
15 x 40 variable Power Otway, $15.50.
Freight payable at nearest attended railway station.

### 420 Mc/s OSCILLATOR

Self-excited 6J6 with power supply and modulation transformer. 5in x 5in x 5in box. 240 volt operated.

**$15.00**

### BATTERY CHARGER KIT

Complete, assemble yourself with instructions. 6 or 12 volts, 2½ amps. $7.95.
Post: N.S.W., 70c; Interstate, 95c.

### RECORDING TAPES

SCOTCH BRAND.
EX-WOOMERA.
SLIGHTLY USED.
PERFECT ORDER.

Can be used for home video, tape recording equipment, etc.
2,400ft 12in Reel ½in Top Grade. Cost $14.50. Our price $7.50 roll. Post 70c; Interstate, 95c.
Also same in ¼in. Ideal for professional quality audio recording.
1200ft 7in reel ¼in $2.75. Post 12c.
600ft 5in reel ¼in $1.68. Post 12c.
200ft 3in reel ¼in 65c. Post 10c.

### SCOOP PURCHASE

Gramo. Motors. New. Made in U.S.A. 4-speed. 240 volt A.C. 50 cyc. Only $2.75 each.
Post, N.S.W., 30c; Interstate, 40c.

### 240-110 VOLT 6KVA TRANSFORMERS

Encased, including switches, as new. $50.

Top grade, fully enclosed transformer, 1 Kva primary 218/240 vac. 50 cycs. secondary 6 volt, 37 volts, 53 volt, 60 volt, $30.

### LEAD ACID BATTERIES

New 2 volt 1.5 amp. $1.75, 12 volt 0.75 amp. $3.75.
Post, N.S.W., 25c; Interstate, 30c.

SPECIAL lucky dip valve offer. 15 new valves in cartons for only $2.00. We haven't got time to sort them, so you reap the benefit. Post, 30c.

### SOLENOIDS

Plunger Type 12V 300M.A. Suit electric camera control.
MINIATURE TRAINS,
radio, etc. $1.25. Post, 10c.
200 Mill. amp., 240 volt; ⅛in push movement.
$1.25. Post, 10c.

### BATTERY CHARGER

6 or 12 volt, 2½ amp. $9.95.
Post, N.S.W., 70c; Interstate, 95c.

### TELEPHONES

Sound Powered. Can be used as Microphone and Receiver. New. With 50ft cable.
$3.85 pair.
Post, 25c; Interstate, 40c.

# DEITCH BROS.

## 70 OXFORD STREET, SYDNEY

SORRY, NO C.O.D.

### BEIRUT USES 5970KC

Radio Lebabon, at Beirut, in its home
rogram in Arabic, has made a slight fre-
uency change and now is being heard on
970KC, replacing 5980KC, for the relay
f its Arabic programs from 0430 to 0730-
iMT. The frequency now used gives good
eception at 0700 after the Radio Canada
ation leaves the frequency. At 0700 time
ips are heard and then the station identi-
cation in Arabic, with a lady announcer,
hile a short news bulletin in Arabic is
eard with a male newsreader. At 0705GMT
e Radio Lebabon program continues in
pical Arabic musical programs, and when
eard was covered by Radio Canada at the
pening of its service to Australasia at
725GMT, but the Lebanon station leaves
e air at 0730. This new frequency, a drop
f 10KC, appears to have been made to
void the interference it would otherwise
iffer in the European area from Radio
loscow, which uses 5980KC.

### BBC EXPANSION CONTINUES

The expansion of the BBC External
ervices from London and over its relay
ises continues. The 1965 BBC Handbook
ows that the Corporation now operates
transmitters in Britain and at overseas
lay bases. These transmitters are to be
pplemented by four more 250KW units
ing built in Britain, to be located at one
the four transmitting sites in the United
ingdom, while a further four 250KW
insmitters are under construction at the
w BBC relay base on Ascension Island
the South Atlantic.

Some 41 high-powered transmitters,
nging from 50 to 250KW, are located at
e four transmitting sites in Britain. One
ort wave station at Tebrau, Malaysia, has
o high-power and four low-powered trans-
tters. One BC station and VHF station
Berlin, the East Mediterranean relay, has
ee BC and eight SW transmitters. Malta
s one BC relay station. Another BC relay
at Perim Island in the Gulf of Arabia,
d one short wave station is at Monrovia
Liberia, where one 10KW transmitter is
ed. Ascension Island has one short wave
nsmitter of low power, with four high-
wer transmitters under construction as
ntioned above.

### NEW TRANSMITTERS

Nigeria is reported to have signed a con-
ct for the construction of a new 500KW
dium wave transmitter for the Nigerian
oadcasting Corporation. The station is to
located at Enugu, in Eastern Nigeria, and
l use 953KC. Another report states that
ugu is using 620KC with a new high-
wer transmitter and is asking for reception
orts; this could be the new station already
operation on another frequency.

Portugal is reported to be using four
KW transmitters, and is now making
otiations for the purchase of two 250KW
nsmitters for its short-wave services.

### NEW PHILIPPINES STATION

nother new gospel station is scheduled
come into operation in the Philippines
July when "Radio Veritas" goes on the
with one 100KW BC transmitter and
100KW SW transmitters. The station
beam Catholic programs in 17 languages
ughout all of Asia and Oceania, accord-
to a recent announcement from Vatican
io. The new station will cost over £2m
this money has come mainly from
t Germany. At present there are three
holic stations in the Philippines, and at
three more are planned. Radio Veritas
be the third strongest radio voice in the
ippines on MW, and should provide
reception on both medium and short
e in the South Pacific.

## BROADCAST STATION SCHEDULE CHANGES

Radio Canada, Montreal in its service to Australia and New Zealand has retimed its transmissions and is now heard one hour later, on the same frequencies. The new time is 0830-0930 replacing 0730-0830 the previous transmission time.

The service to Africa which is on a test basis now is on the air at the time formerly used in the Australasian service. The new schedule for Radio Canada transmissions from Montreal is as follows:

| | | |
|---|---|---|
| 0725-0820 | To Africa | 5990, 9625 |
| 0830-0930 | To Australasia | 5970, 9625 |
| 1025-1214 | Europe—1 | 17820, 15320, 5970. |
| 1215-1313 | Europe-North America | 17820, 15320, 5970 |
| 1345-1830 | Europe —2 | 17820, 15320, 11720 |
| 1830-2000 | African Service | 17820, 15320, 11720 |
| 2000-2150 | Europe—3 | 17820, 15320, 11720 |
| 2200-2245 | Northern Canada | 15190, 11720, 9625 |
| 2300-0045 | Latin America | 15190, 11725, 9625 |
| 0100-075 | Northern Canada—2 | 15190, 11720, 9625<br>(15190 0100-0230 only) |

### VOICE OF GERMANY

The new schedule of the Deutsche Welle station at Cologne, The Voice of Germany, has some major changes in its English transmission. The frequencies in use to Australia and New Zealand have been altered, as well as some used by the Cologne and Kigali relay station in Africa.

| | GMT | KC |
|---|---|---|
| Australia and New Zealand | 0845-0945 | 9640, 15275, 17845 |
| | 2110-2200 | 7290, 9685 |
| South Asia | 0330-0340 | 7225, 9530 |
| | 1550-1620 | 11775, 15295 |
| Africa | 0600-0630 | 11785, 15275, 17845 |
| | 1100-1115 | 11930, 15280, 17870 |
| | 1645-1710 | 15275, 17845 |
| | 2145-2205 | 9735, 11925 |
| West Africa | 0545-0630 | 11905 |
| | 1200-1245 | 11765 (Kigali) |
| | 1745-1830 | 17805 (Kigali) |
| Central Africa | 0430-0500 | 9565 |
| | 1045-1115 | 9735 (Kigali) |
| | 1645-1730 | 9740 (Kigali) |
| North America (East) | 0130-0250 | 6075, 9640 |
| | 1045-1055 | 9605, 11905 |
| | 2050-2100 | 6145, 9735, 11925 |
| North America (West) | 0500-0540 | 6145, 9735 |
| | 1510-1550 | 9675, 11795, 11925 |

### WWV SITE MOVED

he well-known frequency and time
on WWV operated by the National
au of Standards in Washington, D.C.,
be moved and new transmitters, located
ort Collins, Colorado, will take over
the services as from July 1. The present transmitters of WWV are located outside Washington, at Greenbelt, Maryland. The WWV transmissions are well known to short wave listeners, who use them for accurate calibration of receiver frequencies; also the familiar time announcements enable the exact time to be checked each five minutes on any of the six frequencies used by WWV to permit reception world wide on at least one frequency at any time of the day or night.

The new location will be near the Radio Standards Laboratory of NBS. The new site will enable WWV to give a more efficient service from a better transmitting location, and be heard with better signal level in all parts of the world. The station operates on 2500, 5000, 10,000, 15,000, 20,000, 25,000 and 30,000 KC continuously, and as well as giving time announcements in voice and morse, provides details on sunspot count, ionosphere conditions, etc. Eight transmitters will be at the new station, six for WWV and one each for WWVB (low frequency) and WWVI (very low frequency) stations.

In June, 1965, a contract worth nearly $270,000 was let for the eight transmitters for the new station at Fort Collins. Four of the transmitters are of 20KW, four of 5KW The higher powered transmitters will be on 50000, 10000 and 15000KC. Special antenna towers have also been erected at the station, ranging in height from 20ft to 200ft. WWV was established in Washington in March, 1923, as the United States' first standard frequency station and has grown from a 1KW station on one frequency to the present station.

## FLASHES FROM EVERYWHERE

**IRAN** over Radio Teheran is providing excellent reception in the 80M ham band, using the frequency of 3780KC with the power of 100KW. The signals on Saturday 1930-2030GMT are made up of a request program and most of the items played are American and English popular numbers. The frequency, off the normal 75M band, gives excellent reception and at the hour of reception little amateur activity on the band makes the frequency clear of interference.

**SOUTH AFRICA** with its new 250KW transmitter continues to give good reception of 4895KC. The signals, with the 250KW transmitter, are the best from Africa in our location and the program includes an hour in Portuguese from 1800-1900 and then at 1900 a newscast in English is heard. The station address is Radio South Africa, SABC, Johannesburg. The program includes 1500 ZULU: 1600 English; 1700 French; 1800 Portuguese; 1900 English; with close down 2100GMT.

**CEYLON'S** Overseas Service from Colombo has programs to Europe, North Africa and the Middle East to sign off at 0815GMT. The station is using the frequency of 15330KC. The Radio Ceylon program is also being heard on 1782KC and this one has news in English at 0930GMT.

**UNITED NATIONS** programs are frequently heard on short wave, and some of those best received in the Pacific were listed by Radio Australia DX Session. Philippine relays of the U.N. Radio 0630-0730 on 9665, 11830; South-East Asia 1000-1100, using 17820KC for the

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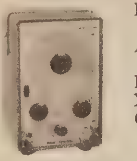

TE-20D

**Freq.** 120KC-500MC (7 Bands)
Accuracy. 2 p.c.
**AF Output.** 8v400cps.
**Mains operated.** 240v.
**Xtal Socket.**
**Complete.** Test leads inst. book.
$27.25

TE-20

**Freq.** 120KC-260MC (6 Bands)
**Accuracy.** 2 p.c.
**AF Output.** 8v400cps.
**Mains operated.** 240v.
**Complete.** Test leads. instruction book.
$26.50

AUDIO GENERATORS

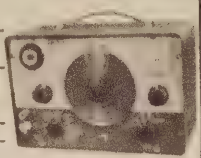
TE-22

**Freq.** 20cps-200KC. (4 Bands)
**Output.** Sine 7v, Square 7v P-P.
**Distortion.** Less than 2 p.c.
**Output Impedance.** 1000 ohm.
**Freq. Response** 60cps-150KC ± 1.5 DB.
**Complete Test** leads instruction book.
$38.50

TE-22D

Same as TE-22 only has 4 step attenuation.
$39.25

C. R. ANALYSER



T E-46 Bridge.
**Capacity.** 20uuf-2000uf (4 Range).
**Resistance.** 2ohm-200Mohm (4 Ranges)
**Tests.** Power factor, leakage, impedance, transformer ratio and insulation resistance to 200Mohm at 600v.
**Mains operated.** 240v.
**Complete.** Test leads, etc.
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We wish to advise that all correspondence and orders in Western Australia should be forwarded to P.O. Box 3, Inglewood, W.A. as we have appointed an agent in this area who has stocks of all items advertised by us.

We have the facilities and spares to service all instruments advertised by us. All inquiries P.O. Box 86, Broadway, N.S.W.

first 30 minutes, then 15315KC, and from 1030-1100 only 15410KC is in operation. Australia and New Zealand are served on 11845, 9665, and 5985KC from 8.45 to 0900GMT. In English for Malaysia 0230-0245 they use 17850, 17705, 15365, 15185KC, all carrying this English program.

**NORTH KOREAN** Radio Pyongyang has verified our reception and states they are on the air in English to the Near and Middle East and Africa, 0400-0500GMT on 14520, 15520; 1900-2000 on 6540, 7580. For South-East Asia, 0800-0900, 1100-1200, 1400-1500 on 7580, 13780KC. Pyongyang also broadcasts in French, Chinese, Korean, Japanese and Russian.

**SAUDI ARABIA** is reported on two new frequencies with the transmissions from Jeddah in Arabic, and using 6165 and 7300KC at 2000 to 2200GMT. Another transmission at 0400 has been noted on 9670 and 9720KC with the usual Arabic program.

**CANARY ISLAND** Radio National de Canarias, Santa Cruz de Teneriffe, on 9660KC is now on the air from 1700 to 1900GMT, and remains on 9660KC for this transmission which replaces the former 1400-1600KC transmission. The station of Radio Nacional Espania in Madrid and has been heard on two frequencies, the other being 11800KC.

**HONDURAS** station HRVC, a new gospel station, with 5000W on 4820KC, is located in Tegucigalpa and is heard announcing as a station of the Association Missionary Bautista at 0310 to 0334 in English. The programs originate from HCJB in Quito Ecuador, reports World Publications bulletin.

## BROADCAST BAND NEWS

**INTERNATIONAL WATERS.** News of Radio Scotland discloses that this station is being widely received in northern Britain. The station is on the air 0600-1930 and 2230-0300GMT on 242M or 1236KC. The station has the mailing address, Radio Scotland, 38 Bath Street, Glasgow C2, Scotland. Radio Scotland is in the Clyde estuary and it uses 20KW of power on its frequency of 1236KC.

Nine off-shore radio stations now operate off the coast of Britain and the efforts of the British Government have so far not closed them down. Radio London has now extended its time to 20 hours a day, from 0600 to 0200GMT, and is using 1129KC. Radio City, located on an abandoned wartime gun platform in the Thames Estuary, plans to operate 24 hours a day during the British summer period.

**NEW ZEALAND.** The Invercargill National station 4YZ received a power boost on April 16 when power was increased from 5KW to 20KW. The station, which carries the NZBC National Program, is operating on 720KC and its old transmitter, had been in use for nearly 30 years. The station is on the air 1800-1120GMT daily.

A new NZBC station 1ZO in Tokoroa has commenced tests on 1480KC with 2KW, and in its initial program period is carrying the programs of 1XH in Hamilton. The station, it is understood, will originate its own programs, and also carry the balance of its transmission time on relay from the Hamilton stations.

**AUSTRALIA.** The Australian Broadcasting Control Board have been asked by the Postmaster-General to call applications to operate three new commercial stations in Queensland. The sites of the new stations will be in the Gold Coast, Atherton and Innisfail-Tully areas.

The Postmaster-General, Mr Hulme, said he had approved the establishment of these three stations in Queensland, because of the need for improved broadcasting services in the areas, and th ception of commercial programs in area was not adequate. Owing to limited number of frequencies avail licences would be granted subject to tain technical conditions designec avoid interference with stations in tralia and New Zealand already oper on the frequencies to be used.

The third new Australian Broadca Commission station to begin oper in Queensland in recent months officially opened April 7, when 4Q St. George commenced to operate 710KC, using the power of 10KW. is the last of the three projected Queensland stations to come into se 4QO on 910KC and 4QD 1550KC previously been reported in these pag being in service. The new 4QW i the air 2000-1407GMT except for S day when sign on is at 2030GMT, shares the frequency with the 7NT ceston, Tasmania, station also using KW on 710KC.

**NOTES from readers should be sent ARTHUR CUSHEN, 212 Earn Stre Invercargill, N.Z. All times are Gree wich Mean Time, add 8 hours f Perth, 10 hours for Sydney, 12 hou for Wellington time. All frequenci are in kilocycles.**

**KUWAIT.** The world's most pow national broadcasting service is to built at Kuwait in the Persian Gulf. station, known as the "Voice of Kuw will use three 750KW transmitters o broadcast band and cover the major of Asia and the Near East from point. A contract was recently s with Marconi of England for these transmitters, which are the highest p ed transmitters yet produced in the w and the cost will be more than The supply and installation of the transmitters will be completed next Six Kuwaiti engineers will be train the Marconi factory, Chelmsford, land, in the maintenance of these powered transmitters, which incorp transistor stages in the design. Th tion at present uses 559, 1130 and KC and it is expected the new mitters will operate on these channels

**HONG KONG.** The reception of the ond outlet of the Hong Kong Comm Broadcasting Co. Ltd., in its Ch program, has been heard on 117 The program, the same as on 105 included news in Chinese at 1500, lowed by a march used as the at 1510, and then light music to The station identification given woman announcer was then heard, a program of Chinese music to down at 1600GMT. An airmail cation letter has been received fron station which confirmed our receptic 1170KC, and gives the power of new outlet as 2KW. The station ad is: P.O. Box 3000, Hong Kong, whi the mailing address and the verific letter was signed by Mr W. S. Ip, E eering Department of Radio Hong Commercial Broadcasting Co. Ltd.

### TELEVISION DX

Signals from the NZBC's Dunedin vision signals DNTV2 have been good reception in Katoomba in the Mountains of New South Wales, rec on Australian Ch. 1. Graeme Wilso Katoomba, reports receiving the signa DNTV2 during the morning on Satu and Sundays, and picture quality was good during the period November to F ary. The antenna used was designe Australian Ch 2, and the DX receptio this aerial was extremely good. He pla install an all-band antenna to try to more interesting signals during the su this year, when the New Zealand s should again be receivable in Australi

# TECHNICAL BOOKS AND PUBLICATIONS

## or Engineers and Students

**:EDBACK CIRCUIT ANALYSIS, by S. S. Hakim, Ph.D., B.Sc., A.M.I.E.E. Professor of Electrical Engineering, McMaster University, Hamilton, Ontario, Canada. Published by Iliffe Books Ltd., London, 1966. Hard covers, Demy 8vo. (5-5/8in x 8¾in), 392 pp. Many circuits and diagrams. Price in Australia $16.60.**

In this modest-sized volume Prof. Hakim s provided the practising engineer, techian and student with an excellent text d reference covering the topic of feedck circuit analysis. Inspection reveals it be both concise and comprehensive in ntent and admirably lucid in style and sentation; an "engineering level" text of very best kind.

To demonstrate this the following is a ef run through the topics in their order presentation.

Chapter 1 gives a brief introduction to dback concepts and applications. The cussion then begins in earnest in chapter headed "Linear Circuit Analysis;" here author spends some 94 pages laying wn his theoretical groundwork. The dission starts with circuit elements and rces, passes on to transient response, place transform theory and the complex quency domain, defines unit-step, unitpulse and unit-ramp functions, and introes network functions. It then deals with p-function response of one- and two-pole works; plotting on the p- or s-plane; nping factor and overshoot; steady-state plitude and phase response; responses of works having various combinations of es and zeros; matrices; two-port netrks; matrix parameters; coupling of twot networks; the two-port network as a ack box;" reciprocity and passivity; de- equivalent circuits; and valve and nsistor configurations and equivalent cuits.

Chapter 3 is headed "Theory of Feedk." It deals in turn with classical feedk theory and its relationship to gain, ortion and noise; limitations of the sical theory; signal flow diagrams and r use; the concepts of return ratio, re- difference and null return difference; ed loop gain; input and output impedances; feedback and two-port networks; local feedback; multi-stage feedback amplifiers; bridge feedback.

P-plane analysis forms the topic of chapter 4, and this is discussed in considerable detail. There is a most lucid discussion of Routh's method of determining the presence of positive real roots, and a commendably readable yet concise treatment of root locus diagrams and their construction. A number of illustrative examples are given.

The fifth chapter deals with frequency response, introducing Cauchy's theorem and residue theorem; the encirclement theorem; Nyquist's criterion and the T- or jw-plane; stability margins; application of Nyquist's criterion (examples); gain-phase analysis; the phase area and gain-slope theorems; Bode's ideal loop gain characteristic; prediction of closed-loop behaviour from open-loop frequency response; and a graphical method for evaluating the principal oscillatory mode.

The remaining chapters of the book are smaller in individual scope, yet of the same high standard of erudition. Chapter 6 deals with compensating or correcting networks and their design; chapter 7 covers the impedance concept of feedback stability, and gives examples of negative-impedance oscillators and converters; chapter 8 discusses wide-band amplifiers and their particular use of feedback to produce a desired gain/phase performance. Chapter 9 presents the theory of operational amplifiers, and chapter 10 deals with feedback oscillators.

All chapters with the exception of chapter 1 end with a set of carefully-graded self-tutorial problems, the answers for which appear at the end of the volume.

To summarise, I find this an excellent treatise on feedback circuits and their analysis, and one which should be of immense value to both practising engineers and technicians and serious engineering students. It is very difficult to see how it could have been made more informative.

The review copy was an advance proof submitted for review by the Technical Book and Magazine Co. Pty. Ltd., of 295-299 Swanston Street, Melbourne. This firm assures us that copies of the final bound version will be available shortly. (J. R.)

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**:CTRONIC PROJECTS FOR STUDENTS, BEGINNERS AND HOBBYISTS. Published by Philip Stogel Company Inc., 18 East 41st Street, New York, N.Y. 10017, U.S.A. Paper covers, 96 pages size 8¼in x 5½in. Our copy from the publishers. U.S.A. price $1.95.**

he projects described in this small book those gadgets which beginners like to d, because they can mostly be built in r half an hour, and they usually work a fashion, even if the accuracy of such s as meters and testing devices is ect.

ey include such well worn circuits as ystal diode receiver, a one-transistor , followed by a three transistor ver- electronic metronome, "electronic n" (or simple tone generator) and ar items.

l except the last two projects are ry powered, and no valves are used. book is divided into two parts, the first ining very simple circuits which can nade with less than a dozen compo-. The second section tackles more am-s projects. Despite the rather grandiose titles used in some cases, such as home broadcast station, audio mixer, citizens' band transmitter, etc., an examination of the circuits shows they are within the scope of any beginner who can read a simple circuit; perhaps even those who cannot, since a layout sketch or photograph showing interconnection of components is provided in most cases.

The book has one major drawback as far as Australian readers are concerned—the publishers are components manufacturers, and they specify their own parts, which may not be available here. No assistance is given to enable self-winding of coils to be carried out, should it not prove possible to identify direct replacements, and this may create an insuperable difficulty for beginners. Another criticism is that in seeking to explain theory in the simplest possible terms, the anonymous author has over-simplified to the extent of inaccuracy in some cases. Despite this, there is a lot of useful material for a beginner to get this teeth into and, if the specified parts or suitable alternatives cannot be obtained here, they could probably, in the last resort, be obtained directly from the publishers. (H.A.T.)

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**INTRODUCTORY MICROWAVE TECHNIQUES, by Richard W. Tinnell. Published by Holt, Pinehart and Winston. New York, 1965. Paper covers, 8½in x 11in, 111 pp., many circuits and diagrams. Price in Australia $4.05.**

This book is primarily intended for use as a laboratory work-book for university and technical college courses in microwave techniques. To this end the pages are pre-punched for insertion into a ring-bind folder, and scored so that the existing spine may be torn off to facilitate such insertion. The latter are perhaps a little unfortunate, as they make the book rather too flimsy to be used in the normal fashion.

And I feel sure that some will wish to use it in the normal fashion, because quite apart from its intended application it would make quite a useful introductory text on microwave theory and practice. It is remarkably well written, with concise theory, clear explanations and illustrations, and a logical progression of topics. University and college lecturers might thus find it very suitable as an "all-round" student companion for microwave courses.

It should be noted that author Tinnell is a lecturer at the Technical Institute of Oklahoma State University.

An introductory chapter gives a brief but concise treatment of transmission-line and waveguide theory. Then follow 16 chapters each dealing with an individual experiment.

Chapters 1, 2, 3 and 4 deal with basic

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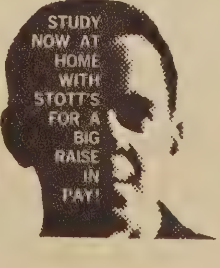
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Here is how I got started right. I had learned about hypnosis revealing past lives. I began to think there must be some inner intelligence with which we were born. In fact, I often heard it said there was; but how could I use it, how could I make it work for me daily? That was my problem. I wanted to learn to direct this inner voice, master it if I could. Finally, I wrote to the Rosicrucians, a world-wide fraternity of progressive men and women, who offered to send me, without obligation, a free book entitled *The Mastery of Life*.

That book opened a new world to me. I advise *you* to write today and ask for your copy. *It will prove to you* what your mind can demonstrate. Don't go through life laughing your mental powers away. Simply write: Scribe S.A.W

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measurements — power, VSWR, frequ
and wavelength, and impedance. Cha
5-10 deal with circuit elements—attenua
klystrons and their operation, tuners, d
tional couplers series and shunt Tee j
tions, and detectors and mixers. Chapte
deals with reflection loss in wavegu
12 deals with microwave propagation
and 14 with primary and secon
antennas. And chapters 15 and 16 di
IF amplifiers, AFC circuits, receiver s
tivity and overall system performance

Three appendices give extremely u
supplementary information. Appendi
gives an introduction to the Smith c
B gives a table of selected waveguide
C gives details and estimated cost of lab
tory equipment required to carry out
experiments.

Incidentally, radio amateurs with
interest in disposals microwave gear
find this book of interest and use, as r
of the equipment suggested and desc
is of the type available from local disp
sources.

Apart from the physical problem
tioned above, it is an excellent little vo
and one which would make an ideal i
duction to microwaves.

Our copy came from the Australian
N.Z. distributors, Rigby Limited, of 2
James Place, Adelaide. Copies shoul
available from all comprehensive b
sellers. (J.R.)

# MAP FOR W.A

**MULLARD-AUSTRALIA PTY. L**
has prepared a new version of the
Circle map, which has been so po
with amateur operators in the Ea
States, but whereas the earlier version
centred on Sydney, the latest versio
centred on Perth, for the benefit of
dents in Western Australia.

The new version is printed in
colour, but otherwise has all the fea
of the original map. It measures 36 x
and is an azimuthal equidistant proje
of the world. A 1966 listing of about
countries and their prefixes is also g
Copies of the Perth-centred map
obtainable from Mullard distributor
W.A., who are Tedco Pty. Ltd.,
Murray Street, Perth. Copies of a re
of the original map centred on Sy
are now available from Mullard-Aus
Pty. Ltd., 35-43 Clarence Street, Sy
The price in each case is $1.20, inclu
postage and packing.

**TRANSISTORS FOR TECHNICAL**
**LEGES, by L. Barnes, M.Sc. T**
**A.M.I.E.E. Published by Iliffe B**
**Ltd., London, 1965. Clothboun**
**paperback, Demy 8vo. (5-5/8i**
**8¾in), 194pp., circuits and diag**
**Price in Australia $6.60 clothb**
**$4.25 paperback.**

Despite the somewhat specific applic
suggested by its title, this little volun
equally suited for use as an introdu
semi-conductor text by engineers,
nicians and serious hobbyists. It is rea
and practical, yet quite a deal of co
basic theory is given for the benefi
those with moderate mathematical
ciency (approximately second year te
level).

There are seven chapters in all.
first explains the fundamentals of
conductor diode and transistor action
second discusses practical aspects suc
gain, leakage current, internal resista
biasing, and power limitations; the
deals with the approximate design of
circuitry. Chapters 4 and 5 deal with s
signal performance, and give equiv
circuits for low and high frequencies.

Chapter 6 deals with switching circ
and includes discussion of multivib
and the Schmitt trigger. And the
chapter gives details of 12 practical e
ments by means of which the colle
private-study reader can become fa

vith the principles discussed in the earlier ections.

Nine appendices give important data not ncluded in the text proper, including parametric conversion tables and details of ther semi-conductor devices.

In short, a well-written introduction to emi-conductors, and one which will be of nterest not only to college students, but to nyone seeking an introduction which combines readable practicality with the essential heory.

Our copy was a rough proof and came rom the Technical Book and Magazine Co. Pty. Ltd., of 295-299 Swanston Street, Melbourne. Properly bound copies should e available from major booksellers in the ear future. (J.R.)

★ ★ ★

**HEWLETT PACKARD CO., APPLICATION NOTE 52, FREQUENCY AND IME STANDARDS,** printed in November, 1965, is a comprehensive revision and xpansion of the 1962 edition. The progress which has been made in the art of time and requency standards and measurement is resented in an excellent manner and will ave considerable impact on the reader who as not given this matter the thought which really deserves. Indeed, those of us who ave tried to keep pace in some modest vay will be almost staggered by the progress, particularly since the late 1950s.

In table form, the art is traced from the .C. tuned circuit, with its order of accuracy of a few parts in 10,000, to the greater ccuracy obtained with the tuning fork, ollowed in turn by the Short Clock. This atter held sway in observatories, etc., beween the two World Wars and was capable f accuracies of a few parts in a million or ven better. After this, the quartz resonator ook over and this is virtually where this ublication begins.

It is difficult to give a complete run-down a few paragraphs on the contents of the 0 pages, but the following will give some lea of the coverage of the subject:

Section 1 (Introduction) gives some eneral comments leading into frequency andards, timekeeping—interval and epoch, adio time signals and local primary standrds.

Section 2 (System Operation, Primary and econdary Frequency and Time Standards) egins with an introduction to frequency andards, followed by primary frequency andards, secondary frequency standards, me standards, frequency dividers and ocks, V.L.F. comparison system, time cord with V.L.F. comparator, power pply considerations, in-plant distribution f standard frequencies and precision variole frequency source.

Section 3 (Methods For Precise Freuency Standard Intercomparisons) begins ith a general discussion on this aspect, llowed by oscilloscope Lissajous patterns, scilloscope pattern drift, direct frequency mparison with a counter, direct counter adout of frequency error and phase noise odulation measurements.

Section 4 (Time Determination) begins ith an introduction, followed by computaon of the great-circle distance, transission modes, relation of time errors to equency drift and frequency determination om time comparisons.

Section 5 (Stability And Spectral Purity Frequency Standards) begins with some neral comments, followed by factors fecting stability, techniques for obtaining ectral purity and quartz oscillators.

In addition, there are six appendices the adings of which are: Time, National andards Of Time And Frequency, Standd Frequency And Time Signal Broadsts, Nomographs And Tables, Definitions d Hewlett-Packard Instruments For Freency And Time Standard Applications.

To sum up, this publication is up to the nute and should be of considerable inest to those who are seriously interested time and frequency standards and mearement.

Application for copies should be made on **mpany letterhead** to Sample Electronics .S.W.) Pty. Ltd., 4 Grose Street, Glebe, .S.W. (I.L.P.).

## ANALOG COMPUTERS

**ELECTRONIC ANALOG COMPUTERS, by G. A. Korn, PhD., and T. M. Korn, M.S. 2nd Edition, McGraw-Hill Book Co. Inc., New York. 9in x 6¼in. cloth bound, 234 pp., 310 illustrations. Price in Australia $18.40 plus post and packing where applicable.**

In the minds of many scientists and engineers as well as laymen, the analog computer still appears to be relegated to a position of secondary importance compared with its digital "brother". Some even go so far as to maintain that it is not really a computer at all, but a sort of sophisticated "Meccano" set.

Yet the truth is that in a great many scientific and engineering fields the analog computer is at least as useful as the digital variety. In fact, in many fields it is considerably more so; while in others, the really big developments have only been made possible by combining both the analog and digital techniques in the recently-evolved generation of "hybrid" computers. Analog simulation plays an essential part in modern science and technology.

In order to use the analog computer to best advantage in any field the scientist or engineer must be fairly clear as to the type of problem for which it is best suited, the way in which it handles problems, the type of "answer" it provides, and so on. And, of course, the computer design engineer needs to have a good grasp not only of these matters, but of the ways in which the machine may be designed to perform its functions.

This book, by the industrial consultants Granino and Theresa Korn, seems well suited to the task of ensuring that both user and designer are thus equipped. It is not a new book, but one which has become established as a comprehensive, detailed introduction to the new analog computer and its design. Apart from a lack of treatment of the recent hybrid techniques it may still be regarded as quite relevant to the current situation.

A run through of the chapter contents gives a fairly good idea of the content and treatment. Chapter 1 gives an introduction to DC analog computers; chapter 2 deals with practical setting-up procedure; chapter 3 discusses the application of DC analog computers to representative practical problems.

Following these general chapters there are those of more specific interest to the designer: chapter 4 deals with the theory and design of linear computing elements, discussing coefficient-setting potentiometers and operational amplifiers; chapter 5 discusses DC amplifiers, and chapter 6 multipliers and function generators. The two final chapters deal with auxiliary circuits, computer operation and the design of complete analog installations.

The book concludes with (a) tables of special computer setups, including operational-amplifier configurations for common transfer functions, transfer impedance tables and generation of time and coefficient functions; and (b) an extensive bibliography.

Throughout the book the text is concise and highly readable, and there are many illustrations.

Summarising, "Electronic Analog Computers" is a well-written and informative volume and one which would be very suitable as both an introductory text and designer's reference.

Our copy came direct from the publishers, but copies should be available at all comprehensive bookstores. (J.R.)

**AWV SEMICONDUCTOR SELECTION GUIDE** is a 16 page quarto size booklet containing basic selection information on more than 600 transistors and diodes, grouped under the following main headings: Transistors for AF Applications—Transistors for Power Switching Applications—Insulated Field Effect Transistors—Temperature Compensating Bias Diodes—Germanium Education Aids—Transistors for RF Applications—Tunnel Diodes—Tunnel Rectifiers—Transistors for Computer Switching Applications—Silicon Controlled Rectifiers—Silicon Diffused Junction Rectifiers—Silicon Rectifier Stocks—Replacement Modules—Rectifier Bridges—Germanium Point Contact Signal Diodes.

Outline drawings are provided, approximately life size, to show the format of various types. A comprehensive index is also included. The booklet is obtainable free and post free from Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, Ermington, N.S.W.

★ ★ ★

**ECCOSHIELD RF SHIELDING MATERIALS** is the title of a brochure published by Emerson and Cuming, Inc., of Canton, Massachusetts, U.S.A. The brochure, which is designed for inclusion in a notebook, provides a ready reference to RF shielding materials of many types. Conductive plastic sheet, gaskets, tubing and O-rings, as well as conductive adhesives, coatings, sealants, lubricants and metallic foil are described, to allow quick and easy selection. The brochure is illustrated and performance data is also included.

Emerson and Cuming have also prepared a new chart printed in four colours show-

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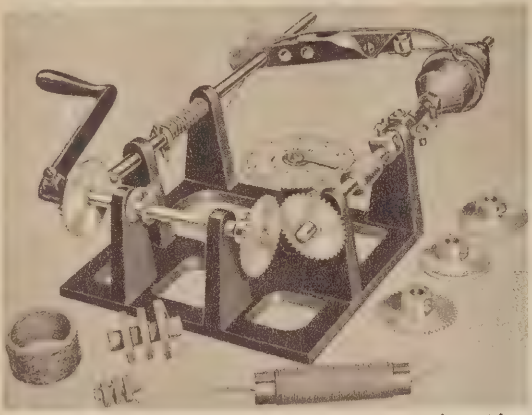

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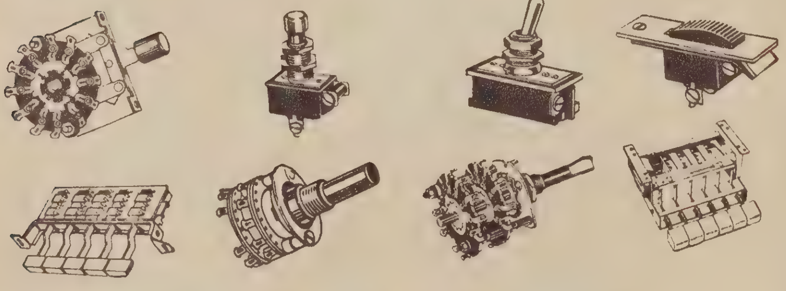

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ing the dielectric constant and loss tan at microwave frequencies of rece developed dielectric materials. The c supplements an earlier one and inclu many items developed since the first was issued.

With dielectric constant as the abs and loss tangent as the ordinate, prod are located on the chart in the manne a graph. Also listed are the maxim use-temperature of each material, and form in which it is available. Definit of various dielectric terms are also inclu The chart is suitable for wall mountin for keeping in a notebook.

Inquiries for both these items sh be addressed to Emerson and Cu agents, who are W. J. McLellan and Pty. Ltd., Kingsgrove, N.S.W.

**HEWLETT-PACKARD JOURNAL** February 1966 (Vol. 17, No. 6) has article entitled "Continuous Monitoring Vertical Interval Test Signal" w describes the signals being transmitte U.S. TV channels for continuously ch ing channel quality. A separate ar describes a new Hewlett-Packard wide- TV waveform oscilloscope designed tests on TV transmission systems. In same issue is a description of the System inter-city TV network in U. which has over 126,000 route miles ( lett-Packard agents in Australia are Sa Electronics (Vic.) Pty. Ltd., Crem Street, Richmond, E.1, Victoria.)

**STC COMPONENTS AND EQ MENT REVIEW** for March (Vol. 3 N announces availability of a new five- semiconductor known as SIDAC, contains a preliminary application and sheet. Other items described are: a range of uniformly spaced ferrite ring c Kuwano Model VP-109 electronic voltm Universal relay Type EP3 for AC or with three changeover contacts; transmi triodes Types 3C/150A and 4279Z; a range of Swiss-made aluminium electro capacitors; miniature industrial re moulded silicon rectifier, EM 400 Se and solid micro tantalum capacitors. ( dard Telephones and Cables Pty. Moorebank Avenue, Liverpool, N.S.W.)

**RANK XEROX (AUSTRALIA) LTD.,** 49 Market Street, Sydney, has pared an article on the preparatio printed wiring boards by Xerography, a reprint of an article describin Xerographic reproducing system, appeared in the March, 1966, issu ELECTRONICS Australia. Copies of articles may be had free and post fre application to the company at the ad given above.

**INFORMATIONS THOMSON,** N (English Edition) contains a descriptio a new high-sensitivity electronic c breaker for low-voltage circuits; and of various activities of this Paris- company, including participation in Exhibition of French Scientific and Me Techniques Abroad, and the comp contribution to European research space problems. (Inquiries should be to Compagnie Francaise Thomson Hou 173 Bd. Haussmann, Paris 8e.)

**NEW DEVELOPMENTS,** the Ja Mitchell and Co. products inform bulletin, has descriptions of the Aqu Water Purity Monitor Type P, and Ele lytic Conductivity Bridge MC-1 MkIV, from Electronic Switchgear (London) Digital Voltmeter DVM1, 5MC Counter TC4 and UHF Millivolt VM79, all from Advance Electronics; Precision Coaxial Attenuator 210A Weinschel Engineering; Analogue Freq Meter M1-4 and Moduline Series Amplifiers from Industrial and Res Electronics; Kienzle Digital Printers SW and D4; Alfred Sweep Ne Analyser System Model 8000/7051; T Engineering Co.'s Series TCC Band Filters; Direct-reading Coaxial Freq Meters from General Microwave Co

(Continued on Page 174.)

# ANSWERS TO CORRESPONDENTS

**Vhen writing to us:—**

**Please give your name and full postal address, including the State . . . N.S.W. &c.**

**Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.**

### RECORD REVIEWS

**McC. (Elsternwick, Vic.)** asks whether an analysis of the record labels which appear in our reviews would provide an indication of the proportion of the total market which each would have.

, there would be no relationship what- r between the two figures. The fre- ncy with which particular labels appear governed more by the number and type records submitted by individual com- ies; this is influenced, in turn, by a iety of factors. Much the same applies book reviews, to product reviews and iouncements, and even to full-scale cles featuring technical activities. Com- ies which put more effort into pub- y and sales promotion tend to reap ater reward in terms of "mention" in news media — newspapers, magazines, io and television. "ELECTRONICS tralia" is in the fortunate position of ing no affiliation with any record com- y, technical book publisher or electronic e organisation.

### LARGER MIXER

**. (Annerley, Qld.)** writes that he would like to add his name to the requests for a more complex audio mixing unit along the lines of the simple unit described in the February issue. While he realises that a unit of the type envisaged would be semi-professional, he feels that such a unit would be welcomed by many readers. He also asks if we could describe an automotive exhaust gas analyser.

y thanks for your thoughts and com- ts regarding a more complex audio r, B.A. Although it will depend upon er interest whether we do eventually ribe such a unit we will certainly give matter some thought. In the mean- , you may note that we have given a deal of information in the February le to enable ambitious readers to "roll own." Your request for an exhaust analyser has been noted. Although devices are not quite in the same class mple instrument as those which we have ribed, we will certainly consider the bility of describing one as a project.

### FM TUNER-AMPLIFIER

**A. (Lae, TPNG)** is in a quandary as to the best purchase for a new high fidelity tuner-amplifier. He queries the wisdom of purchasing a complete system with a built-in FM tuner and/or the advisability of accepting one with FM multiplex circuitry.

often receive this type of query from rs, even to the extent of asking for arisons and personal opinions on com- ially manufactured equipment. In fact, o not compile systematic data on com- al equipment sufficient to make direct arisons. A search through our trade v pages will reveal any information ave on this type of equipment. The FM tuners can be used for listening to some TV sound channels, the stations usually covered being channels 3, 4 and 5 whose sound channel frequencies are 91.75, 100.75 and 107.75MC respectively. We can see no immediate move for FM multiplex in Australasia and feel the purchase of such equipment at this stage would be premature. By far the best solution to your problem is the suggestion made in your letter that an investment be made in a good quality amplifier complete with pre-amplifier, with provision for an external tuner to be fitted at a later date.

### SIMPLE PROJECTS

**P. C. (Caulfield, Vic.)** writes expressing his interest in the ABC-Three radio and similar beginner projects.

Thank you for your suggestions re future articles for beginners which we will keep in mind. We have described some projects in the past with vibrator power supplies but most of these are now out of print. We have not described a pocket-sized test oscillator with modulation but have described a relatively small transistorised service oscillator with three frequency ranges.

### INSECT KILLER

**J. G. (Port Kembla, N.S.W.)** writes asking for the publication of an insect killer based on a high voltage source.

Thank you for your letter and suggestion but at the moment we cannot see any chance of featuring a suitable unit for this application. However a note has been made of the request and it will be considered with other ideas submitted by our readers.

### TAPE AMPLIFIER

**D.G.A. (Elizabeth Vale, S.A.)** says that he liked the recent series on transistorised projects. He wonders whether we could not extend this concept to cover transistorised modules which would allow readers to purchase a tape deck and turn it into a good quality recorder.

There is a world of difference between turning out a batch of unrelated small items and modules capable of being strung together into a complete tape system. In this case, the modules have to work together to produce the desired end result or, appropriately, a variety of end results, since such a project usually unearths a variety of needs. Then there is the problem of reconciling these needs with a variety of decks with a still wider range of head combinations. If quality is one of the basic requirements, as mentioned in your letter, what starts as a simple idea finishes up as a project of major proportions. We may ultimately get round to tackling a transistorised tape system but it probably won't be as straightforward as you apparently hope.

### TONE CONTROL FOR MIXER

**B.B. (Box Hill Nth., Vic)** wishes to add bass and treble controls to each input circuit of the transistorised "Four Channel Audio Mixer" of February, 1966. He asks whether the passive-type controls as used in the May 1963 stereo amplifier would be suitable for this purpose.

Unfortunately not B.B., as this type of transistorised tone control circuit may seriously degrade the distortion and/or signal-to-noise performance in such applications. Also in this particular case the impedance levels are quite different and correct matching would be difficult. A far more satisfactory approach would be to use the feedback-type tone control circuit used in the recent Playmaster 112 Control Unit. The preamp outputs may be connected to the 0.27uF input coupling capacitors, and the tone control stages connected directly to the mixing controls.

### STEREO BROADCASTING

**R.S. (Berowra, N.S.W.)** says that he could listen conveniently to the AM stereo broadcasts, having purchased an imported amplifier unit with twin AM tuners. However, he was deterred by the late hour and by the unduly high-brow content of the programs offered.

Thanks for your remarks, which came to hand too late for inclusion in the "Forum" material on the subject. Your complaint about the programs being too high-brow is in direct conflict with another correspondent who claimed just the reverse!

## "ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of $0-20 (2/-). Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the $0-20 fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at $0-20 PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost $0-50 (5/-) each. Original photographs of most projects are also available, from $0-50 for a 6in x 8in glossy print, postage $0-08 (9d).

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

(10) A fairly good range of back numbers is available. On issues up to 6 months old there is a surcharge of 5c (6d). On issues from 7 to 12 months old the surcharge is 10c (1/-). Over 12 months, it is 20c (2/-).

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# CORRESPONDENTS—Con

### ANOTHER MAGAZ

**L.K. (Hyde Park, S.A.)** Asks why we
not produce a magazine dealing s
with elementary electronics.

We have often been asked questions
similar lines, about producing maga
catering only for particular sections of
readers. The answer is that the Austra
population is not high enough to sup
successful publication of magazines w
are too specialised in their coverage.
try to diversify the subjects in "EL
TRONICS Australia" to meet the den
of all sections of the community but
come letters with constructive suggestio
to the types of articles required.

### PWM AMPLI

**A.H. (Fawkner, Vic.)** asks if we are
sidering the development and cons
tion of a PWM stereo amplifier, cap
of delivering power of 10 watts
over. He would also like to know
problems are associated with
development of such an amplifier.
refers to a particular PWM amp
and says he finds it difficult to be
the specifications.

We have been watching with some int
the development of this kind of amp
and have also noted the varying opin
about them. A basic problem appear
be that of measuring the distortion co
without the readings being swamped by
enormous amount of pulse energy pr
in the output circuit. Their strongest a
may well be on the basis of high o
from cheap transistors, although thi
dependant on the assumption that no
power transistors will remain expensiv
comparison. We suggest that you ha
look at our "Answer Man" for July,
and "Audio Topics" in this issue.

# BOOKS, PUBLICATIONS

(Continued from Page 172.)

tion; Measuring Signal Amplifier
from Wandel and Golterman; and
CEC portable 2-channel Thermal W
Recorder DG5511, (Jacoby, Mitchell
Co. Pty. Ltd., 469-475 Kent Street, Syd

**INDUSTRIAL RESEARCH NEWS,**
56, has an article about Australian z
ceramic materials (zircon being the nat
ly occuring form of Zirconium silicat
which Australia is the world's main
ducer); a description of a new typ
vacuum pump designed to remove
quickly from vacuum systems without i
ducing organic vapours from lubric
and an account of tests carried ou
lightweight concrete materials from b
ing construction. "Industrial Res
News" is published bi-monthly by the
dustrial and Physical Sciences Br
C.S.I.R.O., 314 Albert Street, East
bourne, C.2, Victoria, from whom c
are available free.

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specification may be had from the
quarters of the Association,
Science House, Gloucester Street, Sy
and from branch offices in State c
cities and at Newcastle.

The Association has also announc
proposal to endorse IEC Publication
1965 — Method of Measurement of Cu
Noise Generated in Fixed Resistors
an Australian standard without amend
The text of IEC195 is being issue
comment as Doc. 1046, and copie
available from the offices of the assoc
as given above.

The association invites comment
persons or organisations experience
either of the matters mentioned.

# CLASSIFIED ADVERTISING

**Advertisements in these columns cost $0.50 per line. Each line contains the equivalent of five words each of nine letters. Minimum size of advertisements is two lines. Please note PAYMENT MUST ACCOMPANY ALL ADVERTISEMENTS EXCEPT THOSE PLACED BY ACCREDITED AGENCIES. Your advertisement for the July issue must reach our office before June 7th. Address your advertisement to the Advertising Manager, ELECTRONICS Australia, Box 2728, G.P.O., Sydney.**

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rade, Caringbah, N.S.W.

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3 base stations. Frequency as required, over-
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one 61-5229, Hamilton, N.S.W.

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**YSTONE** communications receiver, current
del 940, perfect condition. 3 RF stages, 5
nd spread, frequency 540KC to 30MC.
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best offer. A. Smith, Box 71, Corrimal,
S.W.

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**LICRAFTERS** model SX110 communications
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used, £125, or exchange for 2-way radio
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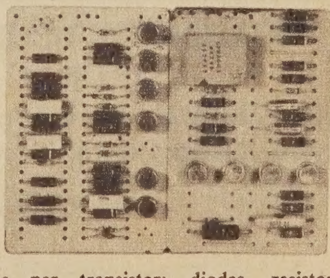

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